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AREA SOURCE EMISSION INVENTORY FOR DOUGHERTY COUNTY, GEORGIA

VOLUME I

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Incorporated

PREPARED FOR
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AREA SOURCE EMISSION INVENTORY

DOUGHERTY COUNTY, GEORGIA

Volume I

Contract No. 68-02-1375
Task Order No. 9
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16. Abstracts

This project was undertaken to prepare an inventory of area sources of particulate matter, SO_x, CO, HC, and NO_x emissions in the Albany area for use in analysis and modeling of air quality in this designated Air Quality Maintenance Area for the period 1975-85. Base year (1973) emissions are projected to 1975, 1980 and 1985, as specified in EPA's regulations governing the preparation of Air Quality Maintenance Plans. Total emissions in thirty categories, including fugitive dust, were allocated into grid squares covering the entire area. The emissions for each grid were estimated by use of EPA's "Area-2 Program". Required input data for this program, aside from pertinent grid information are fuel usage totals and emission factors. The program was modified by PEDCo to accept data input from up to twenty-five source categories requiring both emission calculation and apportioning, and from ten other categories which are best treated as "point sources."

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Carbon Monoxide
Hydrocarbons
Nitrogen Oxides
Statistical Inference
Sulfur Oxides
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Mr. Randy Mayfield was the Project Officer for the U.S. Environmental Protection Agency. The project team is appreciative of the assistance and cooperation extended by Mr. Lee, and other staff members of EPA Region Office IV.

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1. SUMMARY AND GENERAL METHODOLOGY

This project was undertaken to prepare an inventory of area sources of air pollutant (particulate, SO_x, CO, HC, NO_x) emissions in Dougherty county, Georgia for use in analysis and modeling of air quality in this designated Air Quality Maintenance Area (AQMA) for the period 1975 to 1985. A base year of 1973 was specified for the inventory because this is the most recent year for which much of the published national, state, and local data were available.

The base year area source emissions are projected to three different future years--1975, 1980, and 1985--as part of this project. These analysis years are specified in the EPA regulations on preparation of AQMA plans.

The area source categories included in the inventory are shown in Tables 1-1, 1-2, 1-3, 1-4, with the category descriptor codes summarized in Table 1-5. This list of categories was compiled at the initial project meeting of the participants (EPA - Region IV, Georgia DNR, and PEDCo). It is conventional except for the four fugitive dust source categories.

Total pollutant emissions are summarized by category for the base year and three projection years in Tables 1-1,1-2, 1-3, and 1-4. Survey data, emission estimating procedures, and projection techniques that were used to calculate these values for each source category are documented in detail in Chapters 1 through 5 of this report.

Table 1-1. TOTAL EMISSIONS FROM AREA SOURCES - 1973 ton/yr[a]

SOURCE CATEGORY	FUEL USAGE	INPUT UNITS	PARTICULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDROCARBONS	NITROGEN OXIDES
RESCOAL	894.0	TON/YR	6.7	13.9	22.3	5.1	2.0
RESFUIL	508.0	10**3 GAL/YR	2.5	15.7	1.3	0.8	3.0
RESNGAS	934.5	10**6 CU FT/YR	5.0	0.3	9.3	3.7	37.4
RESLPG	1863.0	10**3 GAL/YR	1.7	0.0	1.8	0.7	7.0
COMCOAL	522.0	TON/YR	10.0	8.1	1.6	0.5	2.7
COMRDIL	2153.0	10**3 GAL/YR	24.8	321.8	4.3	3.2	64.6
COMNDIL	2065.0	10**3 GAL/YR	15.3	63.3	4.1	3.1	61.3
COMNGAS	74.5	10**6 CU FT/YR	0.4	0.0	0.7	0.3	4.5
COMLPG	1436.2	10**3 GAL/YR	1.3	0.0	1.4	0.6	8.3
INDCOAL	2511.0	TON/YR	187.1	73.9	2.5	1.3	18.8
INDNDIL	0.0	10**3 GAL/YR	0.0	0.0	0.0	0.0	0.0
INDDDIL	926.0	10**3 GAL/YR	6.9	54.6	1.9	1.4	27.8
INDNGAS	2066.0	10**6 CU FT/YR	10.3	0.6	17.6	3.1	180.8
INDLPG	170.3	10**3 GAL/YR	0.2	0.0	0.1	0.0	1.0
MISC	2364.0	TON/YR	20.1	0.0	59.1	4.7	2.4
GASMVEH	357.6	10**6 VMT/YR	268.0	59.1	30396.9	4533.9	1813.6
DSLMVEH	5.0	10**6 VMT/YR	10.2	15.4	47.3	12.7	138.1
RAILLOC	1432.0	10**3 GAL/YR	18.5	42.2	96.3	64.7	274.2
VESSELS	175.0	10**3 GAL/YR	0.0	0.5	288.8	96.3	0.6
OFHIVEH	7353.0	10**3 GAL/YR	76.7	101.9	3578.5	520.5	1028.8
OFFNBUR	10657.0	TON/YR	89.0	1.1	331.4	82.1	16.0
OFFSBUR	49572.0	TON/YR	421.4	0.0	2478.6	495.7	49.6
EVAPLOS	1517503.0	TON/YR	0.0	0.0	0.0	10319.0	0.0
FUGPRD	3839.1	10**3 VMT/YR	2128.8	0.0	0.0	0.0	0.0
FUGAPD	358.8	10**6 VMT/YR	474.2	0.0	0.0	0.0	0.0

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Table 1-1 (continued). TOTAL EMISSIONS FROM AREA SOURCES - 1973 ton/yr[a]

SOURCE CATEGORY		INPUT UNITS	PARTICULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDROCARBONS	NITROGEN OXIDES
AIRCRAFT	29,500	Engine LTO's	1.8	4.0	366.0	50.6	29.8
INCINERA	1,842	Tons burned	7.9	2.3	9.4	3.9	2.6
FUGITIL	18,747	Acres arable land	173.1	0.0	0.0	0.0	0.0
FUGDST	188.9	Acres exposed	522.9	0.0	0.0	0.0	0.0
Subtotal[b]			4010.6				
FDPAVRD			474.2				
Total			4484.8	778.8	37,721.2	16,212.9	3774.9

[a]Totals respective to entire study area.

[b]Does not include FDPAVRD category.

Table 1-2. TOTAL EMISSIONS FROM AREA SOURCES - 1975 ton/yr[a]

SOURCE CATEGORY	FUEL USAGE	INPUT UNITS	PARTICULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDROCARBONS	NITROGEN OXIDES
RESCOAL	688.0	TON/YR	5.2	10.7	17.2	4.0	1.5
RESFOIL	413.0	10**3 GAL/YR	2.1	12.8	1.0	0.6	2.5
RESNGAS	1000.0	10**6 CU FT/YR	5.3	0.3	10.0	4.0	40.0
RESLPG	2248.0	10**3 GAL/YR	2.0	0.0	2.1	0.9	8.4
COMCOAL	564.0	TON/YR	10.8	8.8	1.7	0.6	3.0
COMRCIL	2325.0	10**3 GAL/YR	26.7	347.5	4.6	3.5	69.8
COMDOIL	2209.0	10**3 GAL/YR	16.6	68.4	4.4	3.3	66.3
COMNGAS	80.0	10**6 CU FT/YR	0.4	0.0	0.8	0.3	4.8
COMLPG	1551.0	10**3 GAL/YR	1.4	0.0	1.5	0.6	8.9
INDCOAL	2662.0	TON/YR	198.3	78.4	2.7	1.3	20.0
INDRCIL	0.0	10**3 GAL/YR	0.0	0.0	0.0	0.0	0.0
INDDOIL	982.0	10**3 GAL/YR	7.4	57.9	2.0	1.5	29.5
INDNGAS	1921.0	10**6 CU FT/YR	5.6	0.6	16.3	2.9	169.1
INDLPG	180.0	10**3 GAL/YR	0.2	0.0	0.1	0.0	1.1
WOOD	2057.0	TON/YR	17.5	0.0	51.4	4.1	2.1
GASMVEH	382.8	10**6 VMT/YR	286.9	63.3	27730.1	4030.7	2194.8
DIEMVEH	5.4	10**6 VMT/YR	11.1	16.8	51.6	13.8	150.5
RAILLOC	1289.0	10**3 GAL/YR	16.1	36.7	83.8	60.6	238.5
VESSELS	175.0	10**3 GAL/YR	0.0	0.6	288.8	96.3	0.6
OFHIVEH	29540.0	10**3 GAL/YR	242.2	322.0	11302.0	1643.9	3249.4
OPENBUR	10910.0	TON/YR	91.1	1.1	339.3	84.0	16.4
FFAGBUR	43131.0	TON/YR	366.6	0.0	2150.5	431.3	43.1
EVAPLOS	1548000.0	TON/YR	0.0	0.0	0.0	10526.4	0.0
PDUNPRD	3839.1	10**3 VMT/YR	2128.8	0.0	0.0	0.0	0.0
PCPAVRD	384.4	10**6 VMT/YR	508.0	0.0	0.0	0.0	0.0

Table 1-2 (continued). TOTAL EMISSIONS FROM AREA SOURCES - 1975 ton/yr[a]

SOURCE CATEGORY		INPUT UNITS	PARTICULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDROCARBONS	NITROGEN OXIDES
AIRCRAFT	18,028	Engine LTO's	1.1	2.2	192.6	15.0	21.0
IACINAPA	1,842	Tons burned	7.9	2.3	10.7	2.6	2.6
FDAGTIL	11,623	Acres Arable Land	107.6	0.0	0.0	0.0	0.0
FCCCNST	326.1	Acres Exposed	374.1	0.0	0.0	0.0	0.0
Subtotal[b]			3937.0				
FDPAVRD			508.0				
Total			4445.[illegible]	1030.4	42,271.2	16,932.2	5342.9

[a]Totals respective to entire study area.

[b]Does not include FDPAVRD category.

Table 1-3. TOTAL EMISSIONS FROM AREA SOURCES - 1980 ton/yr[a]

SOURCE CATEGORY	FUEL USAGE	INPUT UNITS	PARTICULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDROCARBONS	NITROGEN OXIDES
RESCOAL	358.0	TON/YR	2.7	5.6	8.9	2.1	0.8
RESFOIL	247.[illegible]	10**3 GAL/YR	1.2	7.6	0.6	0.4	1.5
RESNGAS	1168.0	10**6 CU FT/YR	6.2	0.4	11.7	4.7	46.7
RESLPG	3596.0	10**3 GAL/YR	3.2	0.0	3.4	1.4	13.5
COMCOAL	699.0	TON/YR	13.4	10.9	2.1	0.7	3.7
COMROIL	2885.0	10**3 GAL/YR	33.2	431.2	5.8	4.3	86.5
COMDOIL	2740.0	10**3 GAL/YR	20.5	84.8	5.5	4.1	82.2
COMNGAS	93.1	10**6 CU FT/YR	0.5	0.0	0.9	0.4	5.6
COMLPG	1924.0	10**3 GAL/YR	1.7	0.0	1.8	0.8	11.1
INDCOAL	2988.0	TON/YR	222.6	88.0	3.0	1.5	22.4
INDROIL	0.0	10**3 GAL/YR	0.0	0.0	0.0	0.0	0.0
INDDOIL	1102.0	10**3 GAL/YR	8.3	65.0	2.2	1.7	33.1
INDNGAS	1653.0	10**6 CU FT/YR	8.3	0.5	14.1	2.5	144.6
INDLPG	202.0	10**3 GAL/YR	0.2	0.0	0.2	0.0	1.2
WOOD	1442.0	TON/YR	12.3	0.0	36.6	2.9	1.4
GASMVEH	449.0	10**6 VMT/YR	336.5	74.3	15098.1	2598.8	1980.1
DIEMVEH	6.4	10**6 VMT/YR	13.1	19.9	61.0	16.3	176.0
RAILLOC	1556.0	10**3 GAL/YR	19.4	44.3	101.1	73.1	287.9
VESSELS	175.0	10**3 GAL/YR	0.0	0.6	286.8	96.3	0.6
OFHIVEH	10288.0	10**3 GAL/YR	84.4	112.1	3936.2	572.5	1131.7
OPENBUR	11750.0	TON/YR	98.1	1.2	365.4	90.5	17.6
FFAGBUR	40112.0	TON/YR	341.0	0.0	2005.6	401.1	40.1
EVAPLOS	1669253.0	TON/YR	0.0	0.0	0.0	11350.9	0.0
FDUNPRD	3839.1	10**3 VMT/YR	2128.8	0.0	0.0	0.0	0.0
FDPAVRD	451.6	10**6 VMT/YR	596.6	0.0	0.0	0.0	0.0

Table 1-3 (continued). TOTAL EMISSIONS FROM AREA SOURCES - 1980 ton/yr[a]

SOURCE CATEGORY		INPUT UNITS	PARTICULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDROCARBONS	NITROGEN OXIDES
AIRCRAFT	21,306	Engine LTO's	1.3	2.6	234.6	18.6	26.2
INCINERA	1,842	Tons burned	7.9	2.3	10.7	2.6	2.6
FDAGTIL	8,998	Acres arable land	68.7	5.5	0.0	0.0	0.0
FDCONST	428.6	Acres exposed	431.3	0.0	0.0	0.0	0.0
Subtotal[b]			3864.8				
FDPAVRD			596.8				
Total			4461.6	956.8	22,198.3	15,248.2	4119.1

[a]Totals respective to entire study area.

[b]Does not include FDPAVRD category.

Table 1-4. TOTAL EMISSIONS FROM AREA SOURCES - 1985 ton/yr[a]

SOURCE CATEGORY	FUEL USAGE	INPUT UNITS	PARTICULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDROCARBONS	NITROGEN OXIDES
RESCOAL	188.0	TON/YR	1.4	2.9	4.7	1.1	0.4
RESFOIL	147.0	10**3 GAL/YR	0.7	4.5	0.4	0.2	0.9
RESNGAS	1280.0	10**6 CU FT/YR	6.8	0.4	12.8	5.1	51.2
RESLPG	5746.0	10**3 GAL/YR	5.2	0.0	5.5	2.3	21.5
COMCOAL	851.0	TON/YR	16.5	13.4	2.6	0.9	4.5
COMFOIL	3552.0	10**3 GAL/YR	40.8	530.8	7.1	5.3	106.6
COMDOIL	3374.0	10**3 GAL/YR	25.3	104.4	6.7	5.1	101.2
COMNGAS	102.0	10**6 CU FT/YR	0.5	0.0	1.0	0.4	6.1
COMLPG	2373.0	10**3 GAL/YR	2.1	0.0	2.3	0.9	13.6
INDCOAL	3415.0	TON/YR	254.4	100.6	3.4	1.7	25.6
INDFOIL	0.0	10**3 GAL/YR	0.0	0.0	0.0	0.0	0.0
INDDOIL	1259.0	10**3 GAL/YR	9.4	74.3	2.5	1.9	37.8
INDNGAS	1508.0	10**6 CU FT/YR	7.5	0.5	12.8	2.3	131.9
INDLPG	231.0	10**3 GAL/YR	0.2	0.0	0.2	0.0	1.4
MISC	1012.0	TON/YR	8.6	0.0	25.3	2.0	1.0
GASVEH	489.0	10**6 VMT/YR	367.1	81.0	6426.8	1604.0	1009.8
DIESVEH	7.0	10**6 VMT/YR	14.2	21.5	65.9	17.6	192.5
AVELLOC	1719.0	10**3 GAL/YR	21.5	49.0	111.7	80.8	318.0
VESSELS	175.0	10**3 GAL/YR	0.0	0.6	288.9	96.3	0.6
OFFIVEH	11224.0	10**3 GAL/YR	92.0	122.3	4294.3	624.6	1234.6
OFFIBOR	12757.0	TON/YR	106.4	1.3	396.1	98.1	19.1
FARMBOR	37093.0	TON/YR	315.3	0.0	1854.6	370.9	37.1
EXPLOS	2203377.0	TON/YR	0.0	0.0	0.0	14962.6	0.0
FUGVRD	3837.1	10**3 VMT/YR	2128.8	0.0	0.0	0.0	0.0
FUGAVRD	493.0	10**6 VMT/YR	651.5	0.0	0.0	0.0	0.0

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Table 1-4 (continued). TOTAL EMISSIONS FROM AREA SOURCES - 1985 ton/yr[a]

SOURCE CATEGORY		INPUT UNITS	PARTICULATES	SULFUR OXIDES	CARBON MONOXIDE	HYDROCARBONS	NITROGEN OXIDES
AIRCRAFT	26,222	Engine LTO's	1.6	3.2	276.8	22.0	31.4
[illegible]	1,842	Tons burned	7.9	2.3	10.7	2.6	2.6
FUGITIL	7,311	Acres arable land	67.0	0.0	0.0	0.0	0.0
FUGWST	519.2	Acres exposed	582.4	0.0	0.0	0.0	0.0
Subtotal[b]			4083.6				
FDPAVRD			651.5				
Total			4735.1	1113.0	13,813.0	17,908.7	3349.4

[a]Totals respective to entire study area.

[b]Does not include FDPAVRD category.

Table 1-5. SOURCE CATEGORY DESCRIPTOR CODES

Code	Source category
RESCOAL	Residential coal
RESFOIL	Residential fuel oil
RESNGAS	Residential natural gas
RESLPG	Residential LPG
COMCOAL	Commercial-Institutional coal
COMROIL	Commercial-Institutional residual oil
COMDOIL	Commercial-Institutional distillate oil
COMNGAS	Commercial-Institutional natural gas
COMLPG	Commercial-Institutional LPG
INDCOAL	Industrial coal
INDROIL	Industrial residual oil
INDDOIL	Industrial distillate oil
INDNGAS	Industrial natural gas
INDLPG	Industrial LPG
WOOD	Residential wood
GASMVEH	Gasoline motor vehicles
DIEMVEH	Diesel motor vehicles
RAILLOC	Rail locomotive
VESSELS	Vessels
OFHIVEH	Off-highway vehicles
OPENBUR	Open burning
FFAGBUR	Forest fire burn
EVAPLOS	Evaporative loss sources
FDUNPRD	Fugitive dust - unpaved roads
FDPAVRD	Fugitive dust - paved roads
AIRCRAFT	Aircraft
INCINERA	Incineration
FGDAGTIL	Fugitive dust - agricultural tilling
FGDCONST	Fugitive dust - construction

A source category not originally intended for inclusion herein, but which is receiving increased attention, is fugitive dust from paved roads. An accurate quantification of the contribution from this source was difficult. It has, however, been evaluated for its estimated impact on air quality and is discussed as an additional fugitive dust source in Chapter 5. Summary Tables 1-1, 1-2, 1-3, 1-4 include this source as an additional category after subtotalling all other area source emissions.

The procedures used to allocate emissions for each area source category to the grid cells are also explained in detail in subsequent sections. The resulting total emissions by grid for 1973, 1975, and 1980, and 1985 are presented in the Appendices (appended in Volume II). This data can be used directly in the AQMA modeling effort for air quality in the Albany region.

The accuracy of the data used in compiling this area source inventory has been estimated based upon the level of accuracy and reliability of the contacts made and sources used.

Table 1-6 shows PEDCo's assessment of the accuracy (Order 3, highest accuracy) of data used in computing the area-wide emissions, projections, and subarea distribution for each source category. PEDCo has attempted to use the best available data and methods in compiling this area source emission inventory for the Albany region.

Table 1-6. DATA ACCURACY* OF SOURCE CATEGORIES

Chapter	Source category	Area-wide emissions	Projections	Subarea distribution
2	Bituminous coal			
	Residential coal	2	2	3
	Commercial coal	2	2	3
	Industrial coal	2	2	3
2	Fuel oil			
	Residential fuel oil	1	2	3
	Commercial dist. oil	2	2	3
	Industrial dist. oil	2	2	3
	Commercial resid. oil	2	2	3
	Industrial resid. oil	2	-	-
2	Natural gas			
	Residential nat. gas	3	2	3
	Commercial nat. gas	3	2	3
	Industrial nat. gas	3	2	3
2	LPG			
	Residential LPG	2	2	3
	Commercial LPG	2	2	3
	Industrial LPG	2	2	3
2	Wood	1	1	3
3	Gasoline motor vehicles	3	3	3
3	Diesel motor vehicles	3	3	3
3	Aircraft	2	3	3
3	Rail locomotive	2	2	3
3	Vessels	2	2	3
3	Off-highway vehicles	1	1	1
4	Open burning	3	1	2
4	Incineration	3	2	3
4	Forest fires	3	1	2

Table 1-6 (continued). DATA ACCURACY* OF SOURCE CATEGORIES

Chapter	Source category	Area-wide emissions	Projections	Subarea distribution
5	Evaporative loss sources	1	1	1
5	Fugitive dust - unpaved roads	2	2	2
5	Fugitive dust - paved roads	1	1	1
5	Fugitive dust - agricultural tilling	3	2	2
5	Fugitive dust - construction	3	2	1

*Order 1 least detail and accuracy
2 moderate detail and accuracy
3 most detail and accuracy

GENERAL METHODOLOGY

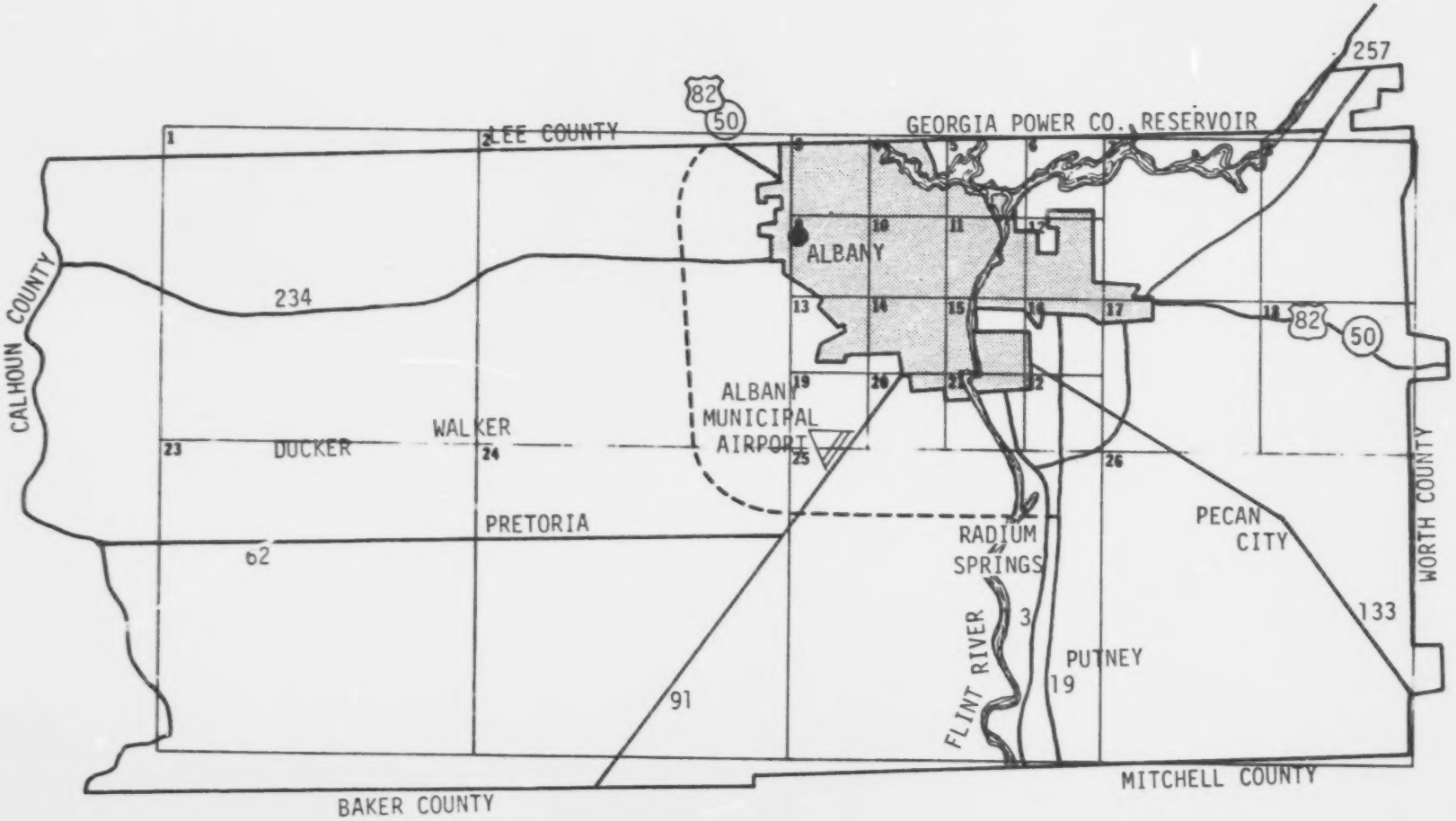
The following describes the data, references, assumptions, and calculations used to estimate area source pollutant emissions for each of the 29 categories in the inventory. A separate subsection is provided for each source category. For each source category, the text is divided into three parts:

1. estimating area-wide base year emissions,
2. projecting base year emissions to the three future years,
3. allocating emissions to subarea grid cells.

Difficulties were experienced in attempting to project fuel usage, particularly fuel oil and natural gas, because of the many uncertainties at this time surrounding the future availabilities and costs of alternate fuels in the Albany area. The intermediate-term impacts of energy conservation programs and the current economic recession further clouded the data available for making assumptions and projections. Overall, the increase in total energy consumption represented by the fuel usage increases shown in this report have been estimated in order to, insofar as possible, keep pace with the population and industrial-commercial growth expected in the Metropolitan area, and maintain a "worst case" analysis. However, expected reductions in per capita consumption of energy may account for future differences.

In order to input area source emissions into the atmospheric dispersion model for AQMA analysis, the distribution of these emissions within the study area must be determined. This was accomplished by allocating the total emissions for each category into grid squares covering the entire area, as shown in Figure 1-1. Three grid sizes are used: 2.5, 5.0 and 10 km. The grid system has 26 grids, and Table 1-7 summarizes the geographical data pertinent to each.

The "Area-2 Program," originally developed by EPA, was employed to enable rapid, accurate calculation and allocation of emissions. Required input data are fuel usage totals, emission factors, and pertinent grid information. The program was modified by PEDCo to accept data input from up to 25 source categories requiring emission calculation and apportioning and 10 categories which are best treated as "point sources." Additionally, the data output now assumes a completely versatile and informative format, suitable for direct inclusion in this report.



I-16-D

I-16

Figure 1-1. Gridded map of Dougherty county, Georgia.

Table 1-7. GRID GEOGRAPHICAL DATA - 1973.

GRID NUMBER	REGION	POLITICAL JURISDICTION	COUNTY	UTM COORDINATES		AREA (KM**2)	STACK HEIGHT (FT)
				X(KM)	Y(KM)		
1	55	0	ALBANY	745.0	3492.0	100.00	30.0
2	55	0	ALBANY	755.0	3492.0	100.00	30.0
3	55	0	ALBANY	765.0	3489.5	6.25	30.0
4	55	0	ALBANY	767.5	3489.5	6.25	30.0
5	55	0	ALBANY	770.0	3489.5	6.25	30.0
6	55	0	ALBANY	772.5	3489.5	6.25	30.0
7	55	0	ALBANY	775.0	3487.0	25.00	30.0
8	55	0	ALBANY	780.0	3487.0	25.00	30.0
9	55	0	ALBANY	765.0	3487.0	6.25	30.0
10	55	0	ALBANY	767.5	3487.0	6.25	30.0
11	55	0	ALBANY	770.0	3487.0	6.25	30.0
12	55	0	ALBANY	772.5	3487.0	6.25	30.0
13	55	0	ALBANY	765.0	3484.5	6.25	30.0
14	55	0	ALBANY	767.5	3484.5	6.25	30.0
15	55	0	ALBANY	770.0	3484.5	6.25	30.0
16	55	0	ALBANY	772.5	3484.5	6.25	30.0
17	55	0	ALBANY	775.0	3482.0	25.00	30.0
18	55	0	ALBANY	780.0	3482.0	25.00	30.0
19	55	0	ALBANY	765.0	3482.0	6.25	30.0
20	55	0	ALBANY	767.5	3482.0	6.25	30.0
21	55	0	ALBANY	770.0	3482.0	6.25	30.0
22	55	0	ALBANY	772.5	3482.0	6.25	30.0
23	55	0	ALBANY	745.0	3482.0	100.00	30.0
24	55	0	ALBANY	755.0	3482.0	100.00	30.0
25	55	0	ALBANY	765.0	3482.0	100.00	30.0
26	55	0	ALBANY	775.0	3482.0	100.00	30.0

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2. STATIONARY SOURCE FUEL COMBUSTION

BITUMINOUS COAL

Area-wide Emissions

An effort was made to determine coal consumption in Dougherty County through contacts with the local coal distributors. As is most often the case, sales figures were not computed in coincidence with geographic boundaries of the study area

The methods used to compute coal consumption involved following the procedures outlined in APTD-1135.[1]

Residential (RESCOAL):

Residential coal consumption was calculated by the "degree day method," computed as follows:

$$\text{Area total} = (\text{Dwelling units using coal})(\text{Heating requirement factor})(\text{No. degree days/yr}) \times \left(\frac{\text{Rooms/dwelling unit - study year}}{\text{5 avg. room/dwelling unit - U.S.}}\right)$$

The calculations are summarized by county for 1973:

Table 2-1. RESIDENTIAL COAL CONSUMPTION - 1973

County	Dwelling units using coal	x	Heating requirement factor[a]	x	Degree days[b] per year	x	Rooms / D.U. 1/5	=	Coal usage ton/yr
Dougherty	398		0.0012		1,872		5.0/5.0		894
References	2,3		1		4		2		

[a] (Ton coal/dwelling unit - degree day).

[b] (The sum of the negative departures of average daily temperature from 65°F)

The total study area residential coal consumption is then, 894 ton/yr in 1973.

Commercial-Institutional (COMCOAL):

To obtain commercial-institutional coal consumption, the total state residential consumption must be calculated and subtracted from the total state consumption, the result then apportioned to Dougherty County.

Total state dwelling units using coal in 1970[2] = 24,754

Total state dwelling units using coal in 1960[3] = 102,626

Figure an exponential extrapolation ($S=Pe^{nr}$) to 1973,

where, $r = \frac{\ell n\ S/P}{n}$ = -14.22% usage decrease/year.

Therefore,
Total estimated state dwelling units using coal in 1973 = 16,157

Average annual heating degree days (average of Atlanta-2999, Savannah-1597, Albany-1987)[4] = 2,194

Total state residential coal consumption = $(16,157)(2,194)(.0012)(\frac{5}{5})$

= 42,538ton/yr

Then,

State retail dealer's sales[5] = 72,000 ton/yr[a]

less -

State residential consumption = (-)42,538 ton/yr

Total state commercial - institutional coal usage = 29,462 ton/yr

less-

State commercial-institutional point source coal usage[6] = (-) 3,208 ton/yr

Total state commercial-institutional area source coal consumption = 26,254 ton/yr

Apportioning to the study area by population,

$$\text{Total Dougherty commercial-institutional area source coal consumption} = (26,254)\left(\frac{95,804}{4,816 \times 10^3}\right)$$

$$= \underline{522 \text{ ton/yr}}$$

Industrial (INDCOAL):

Total (GA and FLA) "all other" bituminous coal sales - 1973[5] = 388,000 ton/yr

GA coal usage[b] = 388,000 ton/yr

(less) Point source coal usage[6] =(-)261,765 ton/yr

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[a] One hundred percent of the GA/FLA total apportioned to GA based on data provided by the Bureau of Mines: In 1974, GA sales = 63.2% of the total and 100% of the "retail dealers" and "all other" categories. It has been assumed that this same distribution prevailed in 1973, when separate GA/FLA sales figures were not calculated.[5]

[b] Assume that the Georgia and Florida "all other" category is consumed primarily in Georgia.

Total state industrial bituminous coal area source usage = 126,235 ton/yr

Apportioning to the study area by population,

$$\text{Total Dougherty County industrial bituminous coal area source consumption} = (126,235)\left(\frac{95,804}{4,816 \times 10^3}\right)$$

$$= \underline{2,511 \text{ ton/yr}}$$

The total area source bituminous coal consumption for the Dougherty county region is the sum of the RESCOAL, COMCOAL and INDCOAL categories: 894 + 522 + 2,511 = 3,927 ton/yr.

Emission factors for the three categories were derived from AP-42[8] and are summarized by source category in Appendix A.*

Total emissions from these categories in 1973 are presented below and in Table 1-1.

Source category	Total emissions - 1973, ton/yr				
	Partic.	SO_x	CO	HC	NO_x
RESCOAL	6.7	13.9	22.3	5.1	2.0
COMCOAL	10.0	8.1	1.6	0.5	2.7
INDCOAL	187.1	73.9	2.5	1.3	18.8
Totals	203.8	95.9	26.4	6.9	23.5

* Values for % Sulfur and % Ash can be found in Appendix A-5.

Projections

Residential coal usage is steadily declining due to home heating conversions to natural gas and electricity. New homes that use coal as a heating fuel are not being built. Also, coal heated buildings are often quite old and subject to demolition in urban renewal and highway projects. Projections, therefore, were based upon the estimated number of dwelling units using coal in the projections years, derived by the exponential extrapolation method previously described.

In arriving at these values, it was assumed that the number of houses using coal would continue to decline at the same rate/year as was consistent with the 1960-1970 trend, (Appendix B).

Year	1973	1975	1980	1985
No. houses using coal	398	307	160	83
Growth factor	base	.77	.40	.21
RESCOAL consumption (ton/yr)	894	688	358	188

RESCOAL emissions for the projection years are presented in Tables 1-2, 1-3, 1-4, assuming that the same emission factors and fuel sulfur and ash contents prevail as in 1973.

Commercial-institutional coal usage in the future was assumed to reflect the economic climate projected for the Albany air quality control region.

Department of Commerce and County Business Patterns[21] are presented as the best available projection data at this time. Projected emissions are presented in COMCOAL category, Tables 1-2, 1-3, 1-4.

Year	1973	1975	1980	1985
Commercial labor force	24,973	27,183	33,371	41,106
Growth factor	base	1.08	1.34	1.65
COMCOAL usage (ton/yr)	522	564	699	861

Industrial area source coal consumption, in consonance with commercial-institutional usage, will most probably increase in the future due to the expected continuance of critical supply shortages and higher costs of cleaner burning fuels. In the absence of detailed statistics revealing projected energy market demands, industrial growth has been estimated based on manufacturing labor force projections for all manufacturing industries.[7]

Year	1973	1975	1980	1985
Manufacturing employees	7,128	7,524	8,514	9,702
Growth factor	base	1.06	1.19	1.36
INDCOAL usage (ton/year)	2,511	2,662	2,988	3,415

INDCOAL emissions for the three future years are presented in Tables 1-2, 1-3, 1-4.

Subarea Distribution

Apportioning of pollutant emissions from Dougherty County area source bituminous coal combustion to grid cells was based on the following factors for each source category:

RESCOAL	-	No. houses in each grid using coal[2,3]
COMCOAL	-	Acreage of commercial land use[7]
INDCOAL	-	Acreage of industrial land use[7]

Allocated emissions for these categories for all study years are presented in Appendices G through J.

FUEL OIL - DISTILLATE

Area-wide Emissions

A survey of several retail fuel oil dealers in Dougherty County yielded much the same vague data as determined from contacts with local coal distributors. Because of these discrepancies in the available data, the degree-day method as described in Reference 1 was used.

Residential (RESFOIL):

Consumption of distillate fuel oil in Dougherty County was calculated by the degree-day method previously described for coal.

Table 2-2. RESIDENTIAL FUEL OIL CONSUMPTION

County	Dwelling units using oil	x	Heating requirement factor[a]	x	Degree days per year	x	$\frac{\text{Rooms}}{\text{D.U.}}\ \frac{1}{5}$	=	Oil usage (10^3 gal/yr)
Dougherty	1,509		0.18		1,872		$\frac{5.0}{5.0}$		508.5
References	2,3		1		4		2		

[a] (Gal. oil/dwelling unit-degree day).

The total Dougherty County area source residential distillate oil consumption is 508.5 x 10^3 gal/yr in 1973.

Commercial-Institutional (COMDOIL):

To obtain the commercial-institutional area source distillate oil usage, the following state data were used:

Kerosene used for heating[9]	=	121×10^3 bbl
Distillate type heating oils[9]	=	$2,984 \times 10^3$ bbl
Distillate used by military[9]	=	95×10^3 bbl
Total		$3,200 \times 10^3$ bbl
		x 42 gal/bbl

Total state commercial-institutional and residential distillate oil consumption $= 134,400 \times 10^3$ gal

The state residential distillate oil usage must be subtracted from the above,

Total state dwelling units using distillate oil in 1970[2] = 67,956

Total state dwelling units using distillate oil in 1960[3] = 106,117

Using an exponential extrapolation ($S = Pe^{nr}$) to 1973, where $r = \frac{\ell n\ S/P}{n}$ = (-)4.45% usage decrease/year.

Therefore,

Total estimated state dwelling units using distillate oil in 1973 = 59,451

Average annual heating degree-days (Avg. of Atlanta, Savannah, Albany)[4] = 2,194

Total state residential distillate oil consumption = $(59,451)(2,194)(0.18)(\frac{5}{5})$

= $23,478 \times 10^3$ gal

Then, $134{,}400 \times 10^3$ gal

(-) $23{,}478 \times 10^3$ gal

Total state commercial-institutional distillate oil usage = $110{,}922 \times 10^3$ gal

less, Total state commercial-institutional point source distillate oil usage[6] = (-)$8{,}102 \times 10^3$ gal

Total state commercial-institutional area source distillate oil usage = $102{,}820 \times 10^3$ gal

Apportioning to Dougherty County by population,

$$\text{Total Dougherty County commercial-institutional area source distillate oil consumption} = (102{,}820)\left(\frac{95{,}804}{4{,}816 \times 10^3}\right)$$

$$= 2{,}045 \times 10^3 \text{ gal/yr}$$

Industrial (INDDOIL):

Industrial consumption of distillate oil was determined using the following state data from Reference 9:

State industrial distillate oil sales = $1{,}584 \times 10^3$ bbl

State sales to oil companies = 56×10^3 bbl

$1{,}640 \times 10^3$ bbl

x 42 gal/bbl

Total state industrial distillate oil usage = $68{,}880 \times 10^3$ gal

Subtracting the industrial point source usage of 22,331 x 10^3 gal/yr[7] from this amount gives an industrial area source distillate oil consumption of 46,549 x 10^3 gal/yr in the state.

This total, when apportioned to the study area by population equals,

Total study area industrial area source distillate oil usage $= (46,549 \times 10^3)\left(\frac{95,804}{4,806 \times 10^3}\right)$

$= \underline{926 \times 10^3 \text{ gal/yr}}$

The total area source distillate oil consumption for the Dougherty county is,

Residential	508 x 10^3 gal/yr
Commercial-institutional	2,045 x 10^3 gal/yr
Industrial	926 x 10^3 gal/yr
Total distillate oil consumption	3,479 x 10^3 gal/yr

Emission factors derived from AP-42 were applied to the fuel totals to calculate emission totals and are summarized in Table A-1 (Appendix A).

The county wide area source pollutant emissions resulting from combustion of distillate oil are:

Source category	Total emissions (tons/year) - 1973				
	Partic.	SO_x	CO	HC	NO_x
RESFOIL	2.5	15.7	1.3	0.8	3.0
COMDOIL	15.3	63.3	4.1	3.1	61.3
INDDOIL	6.9	54.6	1.9	1.4	27.8
Totals	24.7	133.6	7.3	5.3	92.1

Projections

Distillate fuel oil consumption by the residential sector for the future study years was based on the estimated number of dwelling units using fuel oil for heating. In determining these estimates, it was assumed that the county's usage rate through 1985 was consistent with the 1960-1970 trend (Appendix B).

Year	1973	1975	1980	1985
No. houses using fuel oil	1,509	1,228	733	438
Growth factor	base	.81	.49	.29
Fuel oil consumption (10^3 gal/yr)	508	413	247	147

Future RESFOIL pollutant emissions are presented in Tables 1-2, 1-3, 1-4, assuming that the same emission factors and fuel sulfur and ash contents prevail as in 1973.

The majority of emissions from this category will result from the commercial-institutional and industrial sectors where increased fuel oil usage is entirely probable, since

natural gas may be restricted to these users.[10] For this reason, commercial-institutional growth projections were computed according to expected changes in commercial employees. Projected emissions are tabulated in COMDOIL category, Tables 1-2, 1-3, 1-4.

Year	1973	1975	1980	1985
Commercial employees	24,973	27,183	33,371	41,106
Growth factor	base	1.08	1.34	1.65
COMDOIL usage (10^3 gal/yr)	2,045	2,209	2,740	3,374

Industrial growth has been estimated based on projections for manufacturing employees.[21]

Year	1973	1975	1980	1985
Manufacturing employees	7,128	7,524	8,514	9,702
Growth factor	base	1.06	1.19	1.36
INDDOIL usage (10^3 gal/yr)	926	982	1,102	1,259

INDDOIL projected emissions are tabulated in Tables 1-2, 1-3, 1-4.

Subarea Distribution

Pollutant emissions resulting from area source distillate fuel oil combustion were distributed to all grid cells based upon:

RESFOIL = No. houses in each grid using fuel oil[2,3]
COMDOIL = Commercial/institutional land use
INDDOIL = Industrial land use

Computer allocated emissions are tabulated in Appendices G through J.

FUEL OIL - RESIDUAL

Area-wide Emissions

Data for total state consumption of residual fuel oil were obtained from Bureau of Mines data[9] and the computation methods described in Reference 1 were followed.

Residential:

Contact with several major local fuel oil distributors indicated that there was no residential usage of residual oil in the Albany region.

Commercial-Institutional:

The total state consumption of residual fuel oil in 1973 for the commercial-institutional sector is the combination of:

Residual type heating oils[9]	=	$2{,}492 \times 10^3$ bbl
Residual used by military	=	100×10^3 bbl
		$2{,}592 \times 10^3$ bbl
		x 42 gal/bbl
Total state commercial-institutional residual oil consumption	=	$108{,}864 \times 10^3$ gal

Subtracting the state commercial-institutional point source usage by 620×10^3 gal/yr[6] from this total gives the commercial-institutional area source residual oil consumption of $108{,}244 \times 10^3$ gal/yr in the state.

The total fuel usage when apportioned to the study area by population equals,

Total Dougherty County commercial-institutional area source residual oil consumption

$$= (108{,}244 \times 10^3)\left(\frac{95{,}804}{4{,}816 \times 10^3}\right)$$

$$= \underline{2{,}153 \times 10^3 \text{ gal/yr}}$$

Industrial (INDROIL):

The state industrial residual oil consumption in 1973 is a combination of:

State industrial residual oil sales[9] $= 7{,}114 \times 10^3$ bbl

State oil company sales $= \underline{152 \times 10^3 \text{ bbl}}$

$7{,}266 \times 10^3$ bbl

Total state industrial residual oil usage $= \underline{\times 42 \text{ gal/bbl}}$

$= 305{,}172 \times 10^3$ gal/yr

Subtracting the state industrial point source usage of $324{,}786 \times 10^3$ gal/yr[6] from this amount gives a state area source residual oil consumption of (-) 19,614 x 103 gal. Therefore, it is concluded that there is not industrial area source combustion of residual oil in Dougherty County, in agreement with the findings of GA. DNR in their treatment of 1972 data.

The total area source residual oil consumption for the study area is the commercial-institutional total - $2{,}153 \times 10^3$ gal/yr.

Emission factors were determined from AP-42 as in preceeding sections Appendix A, Table A-1, sulfur and ash content is given in Table A-5.

The Dougherty County area source pollutant emissions resulting from combustion of residual oil are:

Source category	Total emissions - 1973, ton/yr				
	Part.	SO_x	CO	HC	NO_x
COMROIL	24.8	321.8	4.3	3.2	64.6

Projections

As with distillate fuel oil, projections for future residual oil usage in the commercial-institutional sector were derived from estimated increases in commercial employment. Growth factors were determined from categories listed as wholesale and retail trade, and service employment and are shown below with projected fuel usage for each study year. Corresponding projected emissions are presented in Tables 1-2, 1-3, 1-4.

Year	1973	1975	1980	1985
Commercial/ institutional employees	24,973	27,183	33,371	41,106
Growth factor	base	1.08	1.34	1.65
COMROIL usage (10^3 gal/yr)	2,153	2,325	2,885	3,552

Subarea Distribution

Allocation of total emissions mirrored the methodology applied for the COMDOIL category. Grid emissions are tabulated in Appendices G through J.

NATURAL GAS

Area-wide Emissions

The consumption of natural gas in the study area is best determined by contact with natural gas distributors. In Dougherty County, natural gas is made available to the public through the Albany Municipal Natural Gas Company, figures were available for Dougherty County alone:

Residential	$934 \times 10^6 ft^3$	
Commercial	$74 \times 10^6 ft^3$	
Industrial	$2066 \times 10^6 ft^3$	(estimated by method described in Industrial (INDNGAS) text)
Government	$298 \times 10^6 ft^3$[a]	

It was assumed that no residential or commercial natural gas usage would be included in a point source inventory and that commercial sales in a metropolitan area as small as Albany would be limited to small usage customers, i.e. small business establishments, commercial concerns using the gas only for heating purposes.

Industrial (INDNGAS):

The industrial consumption of natural gas was computed by apportioning the state total industrial usage of $174,135 \times 10^6 ft^3$ by the population in Dougherty County.[11]

Total state industrial natural gas consumption = $174,135 \times 10^6 ft^3/yr$

---

[a] It was assumed that the governmental gas usage would be included in point source inventory for Georgia.

Subtracting the state industrial point source usage of $70,288 \times 10^6 ft^3$ per year[7] from this amount gives an area source natural gas consumption of $103,847 \times 10^6 ft^3/yr$ in the state.

Then, consumption in Dougherty County is,

$$\text{Total industrial area source natural gas consumption} = (103,847 \times 10^6)\left(\frac{95,804}{4,816 \times 10^3}\right)$$

$$= \underline{2,066 \times 10^6 ft^3/yr}$$

The total area source consumption of natural gas in 1973 in the study area is then:

Residential	$937 \times 10^6 ft^3/yr$
Commercial-institutional	$74 \times 10^6 ft^3/yr$
Industrial	$\underline{2,066 \times 10^6 ft^3/yr}$
Total	$3,077 \times 10^6 ft^3/yr$

Emission factors input to the Area 2 Program with the above fuel totals were from AP-42 and are summarized in Table A-1. The total area source pollutant emissions resulting from the combustion of natural gas follow:

Source category	Total emissions - 1973, ton/yr				
	Part.	SO_x	CO	HC	NO_x
RESNGAS	5.0	0.3	9.3	3.7	37.4
COMNGAS	0.4	0.0	0.7	0.3	4.5
INDNGAS	10.3	0.6	17.6	3.1	180.8
Totals	15.7	0.9	27.6	7.1	222.7

Projections

The natural gas supply situation in most of the southeastern United States is unique. Gas received through pipelines has remained constant for a number of years. Since a finite amount of gas is available, many gas distributors have taken to reduce or stop new sales to industry in order to take advantage of the more lucrative residential-commercial market.

Projections were based on the assumption that new sales to residential-commercial customers would equal a 5 percent yearly increase, and that this figure would be as a result, be taken from the industrial market.

	1973	1975	1985	1985
Residential (RESNGAS)	934	1,000	1,168	1,280
Growth factor	base	1.07	1.25	1.37
Commercial-institutional (COMNGAS)	74	80	93	102
Growth factor	base	1.07	1.25	1.37
Industrial	2,066	1,921	1,653	1,508
Growth factor	base	.93	.80	.73

Subarea Distribution

Emissions resulting from natural gas combustion in the study area were distributed separately by subcategory. Residential emissions from natural gas usage were distributed to all grids based upon the number of dwelling units using natural gas in each grid for each study year.[2,3] Emissions from the commercial-institutional sector were distributed in proportion to the commercial-institutional land use in each grid.[7] Likewise, emissions resulting from natural gas

combustion by the industrial category were distributed in proportion to the industrial land use in each grid.[7] Appendices G through J detail these apportioned emissions.

LPG

Area-wide Emissions

LPG fuel consumption in the study area was determined by following the method outlined in Reference 1 and using the state data from Reference 12.

Total state commercial and residential LPG and ethane gas consumption = $203,658 \times 10^3$ gal/yr

Applying the natural gas ratio to approximate the residential/commercial usage breakdown:

$$\text{Natural gas ratio} = \frac{\text{state residential natural gas usage}}{\text{state commercial natural gas usage}}$$

$$= \frac{86,191 \times 10^6 \text{ft}^3}{47,253 \times 10^6 \text{ft}^3} = 1.82$$

Therefore, the total state residential usage equals $131,439 \times 10^3$ gal/year and the commercial-institutional area source usage = $72,212 \times 10^3$ gal/yr ($72,219 \times 10^3$ gal less state commercial-institutional point source usage of 7×10^3 gal.

Residential (RESLPG):

The Dougherty County residential LPG usage, when apportioned from state totals by dwelling units using LPG[2,3] equals:

$$\text{Residential LPG usage} = (131,439 \times 10^3)\left(\frac{4,464}{315,010}\right)$$

$$= \underline{1,863 \times 10^3 \text{ gal/yr}}$$

Commercial-Institutional (COMLPG):

The Dougherty County commercial-institutional LPG usage, when apportioned from state totals by population equals:

$$\text{Commercial-institutional LPG usage} = (72{,}212 \times 10^3)\left(\frac{95{,}804}{4{,}816 \times 10^3}\right)$$

$$= \underline{1{,}436 \times 10^3 \text{ gal/yr}}$$

Industrial (INDLPG):

Industrial LPG usage was computed as follows:

Total state industrial LPG and ethane sales in 1973[12]	=	$9{,}860 \times 10^3$ gal
Less, state industrial[6] point source usage	=	$(-)\underline{1{,}302 \times 10^3 \text{ gal}}$
Total state industrial LPG and ethane area source usage	=	$8{,}558 \times 10^3$ gal

Apportioning by population ratio:

Total Dougherty County industrial LPG and ethane area source consumption	=	$(8{,}558 \times 10^3)\left(\frac{95{,}804}{4{,}816 \times 10^3}\right)$
	=	$\underline{170 \times 10^3 \text{ gal/yr}}$

The total area source consumption of LPG in the study area is:

Residential	$1,863 \times 10^3$ gal/yr
Commercial-institutional	$1,436 \times 10^3$ gal/yr
Industrial	170×10^3 gal/yr
Total	$3,469 \times 10^3$ gal/yr

As before, emission factors applied to the above LPG consumption to calculate pollutant emissions are documented in Table A-1. The emissions from these 3 categories are:

Source Category	Total Emissions - 1973, ton/yr				
	Partic	SO_x	CO	HC	NO_x
RESLPG	1.7	0.0	1.8	0.7	7.0
COMLPG	1.3	0.0	1.4	0.6	8.3
INDLPG	0.2	0.0	0.1	0.0	1.0
Totals	3.2	0.0	3.3	1.3	16.3

Projections

Trends on the projected usage of LPG are quite difficult to determine. One assumption, since LPG is primarily a residential and commercial fuel, is that it will maintain its share of the market and increase proportionately with the population. However, because LPG is currently more expensive than alternative fuels for home heating, it could be assumed that there will be no increase in its usage.

It has been established in the preceeding section that natural gas will be unavailable for new commercial/industrial users in the future. In addition, the greatest centers of future development will be in the current rural fringe areas surrounding Albany, areas most probably best suited for usage of heating fuels such as LPG and fuel oil. Due to

these considerations, the later assumption was used in projecting LPG usage for 1975, 1980, and 1985. Additional considerations were that the rate of change in number of dwelling units employing LPG for heating in future years was allowed to remain consistent with the 1960-1970 trend (Table B-1). Commercial and industrial usage growth factors were, as in preceeding sections, based on manufacturing employees projections for the Albany AQCR.

Year	1973	1975	1980	1985
No. houses using LPG	4,464	5,386	8,611	13,768
Growth factor	base	1.20	1.93	3.08
RESLPG consumption (10^3 gal/yr)	1,863	2,248	3,596	5,746
Commercial/ institutional employees	24,976	27,183	33,371	41,106
Growth Factor	base	1.08	1.34	1.65
COMLPG consumption (10^3 gal/yr)	1,436	1,551	1,924	2,370
Manufacturing employees	7,128	7,524	8,514	9,702
Growth factor	base	1.06	1.19	1.36
INDLPG consumption (10^3 gal/yr)	170	180	202	231

Projected emissions for these 3 categories are presented in Tables 1-2, 1-3, 1-4.

Subarea Distribution

Computer calculated emissions from the RESLPG, COMLPG, and INDLPG subcategories were allocated to grid calls proportional to their dwelling unit LPG users,[2,3] commercial/ institutional land use, and industrial land use, respectively.[7]

WOOD

Area-wide Emissions

Residential wood combustion was calculated according to the degree-day method described in Reference 1 and previously detailed.

The calculations for residential wood consumption are summarized for Dougherty County in Table 2-3.

Commercial-institutional and Industrial:

There were no data available to indicate the use of wood fuel by commercial-institutional area sources. It is expected to be quite minimal. Wood burning by industrial sources is predominately done as wood waste burning by the wood and paper industries and these are included as point sources. Therefore, commercial-institutional and industrial area source emissions from wood combustion were considered to be negligible.

The emission factors applied to the residential wood fuel total to calculate emissions are included in Table A-1. Pollutant emissions in the Dougherty County region are:

Table 2-3. RESIDENTIAL WOOD CONSUMPTION

County	Dwelling units using wood	x	Heating requirement factor[a]	x	Degree days per year	x	Rooms / D.U. 1/5	=	Wood usage, ton/yr
Dougherty	743		0.0017		1,872		5/5		2,364
References	2,3		1		4		2		

[a] (Ton wood/dwelling unit - degree day).

Source category	Total emissions - 1973, ton/yr				
	Part.	SO_x	CO	HC	NO_x
Wood	20.1	0.0	59.1	4.7	2.4

Projections

Wood as a home heating fuel is definitely declining, especially in the urban area. This is due to home heating conversions and the renovating of older neighborhoods for various urban projects. Therefore, projections of future residential wood usage were based on the 1960-1970 rate of decrease in number of dwelling units using wood, an exponential method was used as previously described (Table B-1).

Year	1973	1975	1980	1985
No. houses using wood	743	644	453	318
Growth factor	base	.87	.61	.43
Wood usage (ton/yr)	2,364	2,057	1,442	1,012

Future pollutant emissions from wood combustion are presented in Table 1-2, 1-3, 1-4.

Subarea Distribution

Allocation of emissions from wood combustion to grid cells was by the number of houses in each grid cell using wood as a heating fuel.[2,3] Grid emissions for all study years are tabulated in Appendices G through J.

3. MOBILE SOURCES

GASOLINE HIGHWAY MOTOR VEHICLES (GASMVEH)

Area-wide Emissions

This category is broken down into 2 subcategories; gasoline powered automobiles and small trucks (LDMV) and gasoline powered large trucks (HDMV). Two methods were employed to determine the vehicle miles traveled (VMT) by these categories in the study area.

1. The first method involved breaking down the fuel sales totals obtained from the State Department of Revenue (Ref. 13).

Total motor fuel sales (includes on-highway and off-highway usage) in study area (1973)	=	$54,580 \times 10^3$ gal/yr
Less; off-highway fuels consumed (OFHIVEH section)	= (-)	9332×10^3 gal/yr
Equals; total on-highway fuels consumed	=	$45,248 \times 10^3$ gal/yr
Less; LPG sold as motor fuel	(-)	196×10^3 gal/yr

Equals; total on-highway gas and diesel fuel sales in study area (1973) = $45,052 \times 10^3$ gal/yr

From Reference 13, the total on-highway diesel fuel sales in Dougherty County in 1973 was 10 percent of total fuel sales or $4,505 \times 10^3$ gal.

Therefore, the total on-highway gasoline consumption in the study area in 1973 equals:

$$\begin{aligned} &45,248 \times 10^3 \text{ gal/yr} \\ (-)\ &\underline{4,505 \times 10^3 \text{ gal/yr}} \\ &40,743 \times 10^3 \text{ gal/yr} \end{aligned}$$

If LDMV's get 13.6 mi/gal and HDMV's 8.4 mi/gal, then

$40,743 \times 10^3$ gal/yr gasoline x 13.6 mi/gal = 554×10^6 VMT = 94.0% of total

$4,505 \times 10^3$ gal/yr diesel x 8.4 mi/gal = 38×10^6 VMT = 6.0% of total

2. Since the State DOT traffic survey data is derived from traffic count measurements, it is assumed more accurate and was, therefore, used as the basis for emission computations. From the 1973 measured traffic counts and computed VMT data (Ref. 14) the following summaries were compiled for the study area.

YEARLY TRAFFIC DATA - 1973

County	Traffic type	Measured yearly VMT x 10^6	% total
Dougherty	Paved	358.8	99.0
	Unpaved	3.8	1.0

The total measured annual VMT would then equal

$$(358.8 \times 3.8) = 362.6 \times 10^6$$

The total VMT's were broken down further into those traveled by gasoline powered vehicles and those traveled by diesel powered vehicles, this was done with the aid of State DOT traffic count figures.

County	Vehicle	Measured yearly VMT's	% of total
Dougherty	gasoline	357.6	98.6
	diesel	5.0	1.4

Emission factors for use with this category were derived from AP-42, Supplement 5, April 1975, incorporating the latest revisions and application of Federal Test Procedure data for EF calculations. The new methodology employed will not be discussed as the procedural changes are too numerous and the calculations too involved for inclusion herein (the reader is referred to Supplement 5, AP-42. In order to account for the combination of LDMV (gasoline) and HDMV (gasoline) VMT, weighted emission factors were computed. The assumptions used in computing the emission factors for each category will be listed and a brief explanation offered for each pollutant EF calculation.

LDMV

The emission factor for particulates is composed of the following components:

exhaust	0.34 gm/mi	
tire wear	0.20 gm/mi	
brake wear	0.02 gm/mi	(Ref. 32)

Particulate emission factor for light duty motor vehicles = 0.56 gm/mi

The factors for emissions and tire wear are published figures from AP-42. The brake wear factor is unpublished but based upon 2 lb worn off per set of brake shoes each 45,000 miles.

Street dust is often times a significant factor in total particulate emissions from vehicle travel. An attempt to quantify this component is presented in Chapter 5, where dust from paved streets has been treated as a separate fugitive dust category.

The above EF for particulates and that for SO_x (0.13 gm/mi) are assumed to remain constant through 1985.

The crux of the new procedures involves calculation of composite emission factors for each calender year under consideration for CO, HC, and NO_x. The assumptions made follow:

1. Typical urban patterns of vehicle operation apply.
2. Average route speed equals 19.6 mph.

3. 20% cold engine operation.

4. Ambient temperature = 51.1°F (Ref. 20).

5. Nationwide statistics for vehicle mix apply.

6. The hot start-up phase for catalyst controlled vehicles is 27% of the operating time.

7. Vehicles are catalyst controlled from 1975-1977.

Then, the composite emission factors are calculated by:

$e_{npstw} = \sum_{i=n-12}^{n} c_{ipn}\, m_{in}\, v_{ips}\, z_{ipt}\, r_{iptw}$, and the resultants shown below.

Year	Composite emission factors (gm/mi)				
	Partic	SO_x	CO	HC	NO_x
1973	0.56	0.13	181.7	9.77	4.3
1975	0.56	0.13	149.4	8.00	4.8
1980	0.56	0.13	58.9	4.5	3.4
1985	0.56	0.13	17.1	2.27	1.09

HDMV(gasoline)

The emission factor for particulates is composed of the following components:

exhaust	0.91 gm/mi	
tire wear	0.30 gm/mi	
brake wear	0.03 gm/mi	(Ref. 32)

Particulate emission factor for HDMV (gasoline) = 1.24 gm/mi

The factors for emissions and tire wear are published figures from AP-42. The brake wear factor is unpublished, but based upon 3 lb worn off per set of brake shoes per 45,000 miles. Again, street dust is a factor in vehicle traffic and a rough quantification of this component is shown in Chapter 5.

The emission factor for SO_x is 0.36 gm/mi. Both these factors are projected (AP-42) to remain constant through 1985.

The calculation of the composite emission factors for CO, HC, and NO_x for HDMV (gasoline) and the assumptions made follow:

1. Vehicle operation is entirely warmed up condition.
2. The vehicle mix is based on nationwide statistics.
3. Average route speed equals 18 mph.
4. The speed correction factor is based on LDMV data.
5. There exists an average of 6 tires per vehicle.

Then, the composite emission factors are calculated by:

$$e_{nps} = \sum_{i=n-12}^{n} c_{ipn} \, m_{in} \, v_{ips}.$$

They are as follows:

Year	Composite emission factors (gm/mi)				
	Partic	SO_x	CO	HC	NO_x
1973	1.24	0.36	219.6	34.6	9.2
1975	1.24	0.36	204.90	30.20	10.20
1980	1.24	0.36	181.90	15.23	11.42
1985	1.24	0.36	138.90	12.23	12.32

The weighted emission factors incorporating those of both subcategories were computed as follows (an example computation for particulate emissions in 1973 is given for clarification):

$$\overline{EF}\ (\text{Partic}) = \frac{.93 \text{ of total VMT } (0.56) + .07 \text{ of total VMT } (1.24)}{(.93 + .7)} =$$

$$0.61 \text{ gm/mi}$$

The following summarizes the weighted EF's computed:

Year	Composite emission factors (gm/mi)				
	Partic	SO_x	CO	HC	NO_x
1973	0.61	0.15	184.4	11.50	4.6
1975	0.61	0.15	153.0	9.55	5.2
1980	0.61	0.15	68.0	5.25	4.0
1985	0.61	0.15	26.8	2.97	1.87

The above EF's were input with the total VMT for LDMV and HDMV (gasoline) vehicles in the study area in 1973 to the Area 2 program to calculate total and apportioned emissions. Prior to this, however, the EF's were converted to $lb/10^6$ VMT to ensure compatability with the fuel total units (Table A-1). The resultant total emissions are:

Source category	Total emissions (ton/yr) - 1973				
	Partic	SO_x	CO	HC	NO_x
GASMVEH	268.0	59.1	30,396.0	4,533.9	1,813.6

Projections

Emission factor development for succeeding study years has already been treated. Projections of annual VMT for gasoline motor vehicles are derived from data acquired from the

Ga. State DOT (Ref. 14).. Estimated VMT projection factors for the county, based on factors pertaining to vehicle registrations, annual vehicle-miles, population and licensed driver distributions, and roads in service were obtained. Using this county growth factor and estimating annual VMT for the county, an overall weighted growth factor for the entire study area evolved. The same ratio of LDMV VMT and HDMV VMT to Total VMT was assumed to prevail through 1985. The projections are:

Year	1973	1975	1980	1985
VMT Growth Factor	base	1.07	1.26	1.36
GASMVEH VMT(10^6VMT/yr)	357.6	382.8	449.0	489.8

Projecting vehicular travel at this time, is a matter to be approached with extreme caution given the following uncertain trends:

1. federal motor vehicle control programs,
2. average new vehicle gas mileage,
3. federal regulations governing gasoline lead content,
4. number of people buying new cars,

All aspects of the current energy market must be brought to bear. Although the above issues all generally suggest declining VMT in the future, other considerations and trends suggest that because of increases in population and probable increases in fuel economy in future motor vehicles, some upward trend in VMT could be expected over the next ten years. The major point to be impressed here is that, although the VMT projection factors probably represent the best available estimates, they should not be regarded as absolute inviolate prophecies of future activity.

Subarea Distribution

Allocation of emissions from all motor vehicle sources was based upon the distribution of total county measured VMT by functional classification (freeway, rural, urban) in each grid cell as determined from traffic count maps (Ref. 14). This total was, of course, composed of gasoline motor vehicles and diesel motor vehicles (truck) traffic. Using the truck traffic percentage factors as previously described, the total was broken into GASMVEH VMT/grid and DIEMVEH VMT/grid (grid apportioning factors). Apportioning factors for future years were projected using the growth factors outlined above.

DIESEL HIGHWAY MOTOR VEHICLES (DIEMVEH)

Area-wide Emissions

This category includes buses and heavy duty trucks using diesel fuel. Since measured VMT data was used to determine the emissions from gasoline motor vehicles, the same VMT data was also used for this category. However, to maintain consistency, the two methods of fuel totals computations are presented for comparison.

1. From the previous section - Method 1, the total study area VMT in 1973 was calculated as 592×10^6 VMT.
The total on-highway fuel sales in Dougherty County in 1973 was determined as 10 percent of the total fuel sales.

Gasoline sales	$40{,}743 \times 10^3$ gal
Diesel sales	$4{,}505 \times 10^3$ gal

That application of distance per gallon factors from APTD-1135 produced a value of 38×10^6 VMT per diesel powered vehicles.

2. The annual VMT attributable to diesel traffic as computed from county traffic count data was calculated in the previous section - Method 2, as 1.3×10^6 VMT/yr.

This value was determined with the aid of state DOT traffic count figures which reflects a significant difference from the value calculated by Method 1. The second method was used for calculating emissions from this category because it was felt that county fuel totals can not account for that amount which may be purchased within the county but used outside of its county.

Emission factors applied to this category were determined from AP-42, Supplement 5, April 1975, in the same fashion as were those for gasoline motor vehicles. Assumptions appropriate to the calculations made will be listed here, also.

The emission factor for particulates is composed of the following components:

exhaust	1.3 gm/mi	
tire wear	0.5 gm/mi	
brake wear	0.05 gm/mi	(Ref. 32)

Emission factor for heavy duty diesel powered motor vehicles = 1.85 gm/mi

The factors for emissions and tire wear are published figures from AP-42. The brake wear factor is unpublished, but based upon 3 lb worn off per set of brake shoes per 45,000 miles. Again, street dust is a factor in vehicle traffic and a rough quantification of this component is shown in Chapter 5.

The EF for SO_x is 2.8 gm/mi and it, along with that for particulates, remains constant through 1985 (Tables A-2, A-3, A-4).

The assumptions made for calculation of the composite emission factors for CO, HC, and NO_x are:

1. Average route speed equals 45 mph.
2. There exists an average of 10 tires per vehicle.
3. All engine operation is in warmed up condition.

Then, the composite emission factors are calculated by:

$$e_{nps} = \sum_{i=n-12}^{n} c_{ipn}\, m_{in}\, v_{ips},$$ and the resultants shown below:

Year	Composite emission factors (gm/mi)				
	Particulate	SO_x	CO	HC	NO_x
1973	1.85	2.8	8.6	2.3	25.1
1975	1.85	2.8	8.6	2.3	25.1
1980	1.85	2.8	8.6	2.3	24.2
1985	1.85	2.8	8.6	2.3	25.2

After converting the emission factors to a $lb/10^6$ VMT basis, they were input, with the DIEMVEH VMT total, to the Area 2 Program for total and apportioned emissions calculations. The EF's in appropriate input form are presented in Table A-1. The resultant emissions for 1973 are:

Source category	Total emissions (tons/year) - 1973				
	Particulate	SO_x	CO	HC	NO_x
DIEMVEH	10.2	15.4	47.3	12.7	138.1

Projections

Projections of future VMT for diesel motor vehicles were developed identically to those for gasoline motor vehicles. The growth factors provided by the GA. State DOT pertaining to the county total VMT projections were assumed to apply to travel by this category also.

Again, the same vehicle mix and ratio of DIEMVEH VMT/Total VMT were assumed to apply through 1985. These projections should be viewed with the same astute awareness as those for gasoline motor vehicles.

Year	1973	1975	1980	1985
VMT Growth Factor	base	1.08	1.28	1.40
DIEMVEH VMT (10^6 VMT/yr)	5.0	5.4	6.4	7.0

Subarea Distribution

Allocation of emissions from this category was performed exactly as that for gasoline motor vehicles. They are tabulated in Appendices G through J.

AIRCRAFT (AIRCRAFT)

Area-Wide Emissions

The effects aircraft have upon air quality are attributable to a single airport of significant size in the study area. The number of operations by aircraft category were obtained by several means, and formed the basis for emissions calculations.

It was desired to obtain FAA Master Records for each airport in the study area. However, personnel at the FAA Regional Office in Atlanta indicated that, due to workload, these would have to be extracted from their files personally by the requester. Therefore, other sources of more readily available published data were consulted to obtain the required information. Aircraft operations at Albany Municipal Airport were obtained through FAA Air Traffic Activity Report.[16]

Emission factors were obtained directly from AP-42. The number of engines for each category is directly obvious except for the air carrier category. Contact with Albany showed that the vast majority of jet air carrier flights in and out of Albany were by medium range jet aircraft. The medium range jet emission factor was used along with the following estimated total engine LTO's for air carrier flights, as shown on the following page.

Projections

Air carrier traffic is expected to increase through 1985. Projections were based on estimates in daily flight totals expected.[38]

EMISSION FACTORS (lb/eng - LTO)

Aircraft category	Part.	SO_2	CO	HC	NO_x
Air carrier[1]	.41	1.01	17.0	4.9	10.2
Air taxi turboprop[2]	.65	0.29	4.85	2.0	1.85
General aviation	.02	0.01	12.20	0.4	0.057
Military[3]	.29	0.45	84.00	15.00	1.70

[1] Medium range jet aircraft value AP-42.

[2] Average value (air carrier and general aviation turboprop) AP-42.

[3] Average value (jet and piston military aircraft) AP-42.

[a] Emission factors for each class of aircraft are based upon LTO operations by mode (e.g. taxi-idle, take-off, etc.) AP-42.

TOTAL EMISSIONS - 1973, ton/yr

Aircraft category	Total eng-LTO	Part.	SO_x	CO	HC	NO_x
Albany						
Air carrier	3,500	.71	1.77	29.8	8.6	20.4
Air taxi turboprop	500	.16	.07	1.21	.5	4.6
General aviation	20,500	.20	1.0	125.0	4.1	.5
Military	5,000	.72	1.1	210.0	37.5	4.25
Total		1.79	3.96	366.0	50.7	29.75

INCREASE IN TOTAL ENGINE LTO FOR AIR CARRIERS ALBANY MUNICIPAL AIRPORT

Year	1973	1975	1980	1985
Estimated daily flight totals	25	11	14	16
Growth factor	base	1.1	1.4	1.6
Resulting increase in air carrier engine LTO per year	3,500	4,000	5,000	6,000

Projections for the air carrier aircraft was used to project total airport values, this should be a reasonable estimate since air carriers reflect the service needs of an area and should be similar to general aviation increases.

It should be noticed that military and air taxi service should at the Albany municipal airport stop by 1975, this is a result of the closing of Turner Naval Air Station. Turner's conversion to a Marine Corp. facility should be complete by 1974. Flight operations have been completely suspended.

Subarea Distribution

Aircraft air considered area sources and the emissions from them are applied to the grids at the airport locations. For purposes of computation then, aircraft emissions were input to the Area 2 Program as "hand calculated emissions" and added to the apportioned emissions of the appropriate grid cells (Appendices G through J).

RAIL LOCOMOTIVE (RAILLOC)

Area-wide Emissions

Emission as a result of railroad activity in Dougherty County area were computed from reported state railroad fuel usage.[13]

Total state fuel oil
(mainly distillate)
usage by railroad (1973) = $2{,}845 \times 10^3$ bbl x 42 gal/bbl
$= 119{,}490 \times 10^3$ gal/yr

This quantity was then apportioned to the study area by railroad track mileage:
Total railroad track mileage in study area = 67.2
Total state railroad track mileage[19] = 5,417
Total county fuel oil usage by railroad = $(119{,}490 \times 10^3)(\frac{67.2}{5417})$
$= \underline{1482 \times 10^3 \text{ gal/yr}}$

Emission factors, based on average locomotive statistics (Table A-1), were applied to the above fuel consumption to yield total pollutant emissions for this category of:

Source category	Total emissions - 1973, ton/yr				
	Part.	SO_x	CO	HC	NO_x
RAILLOC	18.5	42.2	96.3	69.7	274.2

Projections

The railroad industry in general has shown a decrease in activity in the past several decades. However, at least one

factor can be cited to indicate a possible growth trend in railroad activity for succeeding years, provided the recession comes to an end. Although no quantitative measure of this factor was obtained, it remains that the hauling of coal by the railroads is likely to increase as dwindling supplies of cleaner fuels place more importance on coal as an energy source. However, attempts to quantify this increase would be difficult. Subjective indications of railroad activity were translated into a 5 percent increase from 1973 to 1980 and 10 percent increase for the period 1980 to 1985. These percentages were used as the basis for projecting emissions for this category.

Year	1973	1975	1980	1985
Rail (10^3gal/yr)	1,482	1,289	1,556	1,719
Growth factor	base	.87	1.05	1.16

Subarea Distribution

The miles of railroad track in each grid were measured from USGS topographic maps of the study area. The total measured mileage was 67.2. Since the county contains 23.6 miles of mainline track[19] the difference was attributed to grids where major track or yard facilities were noted. Thus, allocating proportionately to the measured track mileage rather than the mainline mileage will more heavily weight the grids containing greater railyard activity. Switch engine activity in the yards was assumed to be included in the emissions allotted to the grids with yard activity. The total emissions from this category were then distributed to each grid on the basis of track mileage contained in the grid.

VESSELS (VESSELS)

Area-Wide Emissions

Estimation of pollutant emissions attributable to vessel traffic in the study area was limited to determining the pleasure boat contribution.

Fuel consumption by vessel activity:

No. registered boats in state[20] = 200,000
Inland water surface area (state)[20] = 803 mi^2
Inland water surface area[a] (study area)[30] = 4.4 mi^2
Fuel usage factor[1] = 160 gal/boat-yr

Fuel consumption (state area) 1973 =
(200,000 boats)(160 gal/boat-yr) =
$32{,}000 \times 10^3$ gal/yr.

Fuel consumption (study area) 1973 = $(32{,}000 \times 10^3)(\frac{4.4}{803})$
= $\underline{175 \times 10^3 \text{ gal/yr}}$

Emission factors for input to the Area 2 Program with the above fuel total were taken directly from the outboard powered vessels section of AP-42 and are listed in Table A-1.

Emissions for 1973 then, are:

Source category	Total emissions - 1973, ton/yr				
	Part.	SO_x	CO	HC	NO_x
VESSELS	0.0	0.6	288.8	96.3	0.6

[a] Includes lakes and streams greater than 1 acre in size.

Projections

In today's conservation intensive fuel market, predicting future fuel use trends is difficult, to say the least. Ideally, predictions for this category would best be made based on estimations of future pleasure boat registrations or fuel consumption.

Taking this into consideration and the additional factor, the aquatic surface area in Dougherty County is quite limited. It is assumed that boating activity has reached a maximum value and future projections should reflect approximately the same value as the 1973 figure.

Subarea Distribution

Pollutant emissions were allocated to grid cells in proportion to the inland water area present therein, determined from USGS maps (Appendices G through J).

OFF-HIGHWAY VEHICLES (OFHIVEH)

Area-wide Emissions

This category includes off-highway vehicles using diesel and gasoline fuels. Typical gasoline fuel users are farm tractors, lawnmowers, compressors, pumps, and small electric generators. Typical diesel fuel users are farm tractors, construction equipment, emergency generator power units, and compressor engines. Of the farm tractors, approximately 60 percent are assumed to be gasoline powered (Ref. 1).

Two methods were employed to check fuel consumption by this category. For the first, state fuel totals were apportioned to the counties by population:

1. Gasoline:

GA State Off-highway Gasoline usage (1973)[13] $= 51,552 \times 10^3$ gal/yr

Study Area Off-Highway Gasoline usage (1973)

$$= (51,552)\left(\frac{95,804}{4,816,000}\right)$$

$$= \underline{1,025 \times 10^3 \text{ gal/yr}}$$

2. Diesel Fuel:

GA. State Off-Highway Diesel Fuel usage (1973)[13]

$$= 1,284 \times 10^3 \text{ bbl/yr}$$

$$\underline{\times \quad 42 \text{ gal/bbl}}$$

$$= 53,928 \times 10^3 \text{ gal/yr}$$

Study area Off-Highway
Diesel Fuel Usage (1973) $= (53,928)(\frac{95,804}{4,816,000})$

$= \underline{1,073 \times 10^3 \text{ gal/yr}}$

The second method entailed applying the fuel use factors published in Reference 1:

1. Gasoline:

Tractor gasoline consumption rate = 1,000 gal/tractor-yr
Total tractors in study area[31 a] = 1,398 (.6)[b]
Gasoline tractors study area = 239

Total tractor gasoline usage = (239)(1,000)
= $\underline{239 \times 10^3 \text{ gal/yr}}$

"Other" gasoline consumption factor[1] = 13 gal/capita/yr
"All other" gasoline usage = 13(95,804)
= $\underline{1,245 \times 10^3 \text{ gal/yr}}$

Therefore, total off-highway gasoline consumption equals $\underline{1,484 \times 10^3 \text{ gal/yr}}$, compared to $1,025 \times 10^3$ gal/yr, calculated by Method 1.

2. Diesel Fuel:

Tractor diesel fuel consumption rate = 1,000 gal/tractor-yr
Diesel tractors in study area = 398 (.35)[b]
= 159

---

[a] 1969 data; assume same number for 1973 due to the normal expected increase being offset by counteracting trends such as decreasing farmland availability due to urban encroachment.

[b] Of tractor total: 60% are gasoline powered, 35% are diesel powered, and 5% are LPT powered.[1]

Total diesel tractor diesel fuel usage = (159)(1,000)
= $\underline{159 \times 10^3 \text{ gal/yr}}$

Construction equipment
fuel usage rate = 5,000 gal/non-bldg. construction employee-yr

Total non-bldg. construction employees in study area[21] = 1400

Total construction equipment
diesel fuel usage = (5,000)(1,400)
= $\underline{7,000 \times 10^3 \text{ gal/yr}}$

"Other" diesel fuel usage factor[1] = 7.4 gal/capita-yr

Total "All Other" diesel fuel
usage = (7.4(95,804)
= $\underline{710 \times 10^3 \text{ gal/yr}}$

Therefore, total off-highway diesel fuel consumption in the study area equals $\underline{7,869 \times 10^3 \text{ gal/yr}}$, compared to $1,073 \times 10^3$ gal/yr, computed by Method 1. Due to inaccuracies inherent with geographical apportioning techniques and the tendency of BOM state totals to be underestimated, the fuel use quantities calculated by Method 2 were used for emissions calculations. Since this whole category was to be considered as an entity, the total fuel usage for input to the Area 2 Program was: $7,869 \times 10^3$ gal/yr + $1,484 \times 10^3$ gal/yr = $\underline{9,353 \times 10^3 \text{ gal/yr}}$.

There are no directly applicable emission factors for off-highway sources. A composite emission factor, based upon a

Table 3-1. EMISSIONS FACTOR DERIVATION-OFF-HIGHWAY VEHICLES

Emission factor	Partic.		SO_x		CO		HC		NO_x	
	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel	Gas	Diesel
gm/mi (1)	0.56	1.53	0.13	2.8	75.9	8.6	10.2	2.3	4.4	25.1
mi/gal (2)	12.2	5.1	12.2	5.1	12.2	5.1	12.2	5.1	12.2	5.1
gm/gal (=1x2)	6.83	7.8	1.59	14.3	926	43.9	124.4	11.7	53.7	128
wt'd avg. (gas & diesel)	$\frac{(20,796)(6.83)+(39,618)(7.8)}{60,414}$		$\frac{(20,796)(1.59)+(39,618)(14.3)}{60,414}$		$\frac{(20,796)(926)+(39,618)(43.9)}{60,414}$		$\frac{(20,796)(124.4)+(39,618)(11.7)}{60,414}$		$\frac{(20,796)(53.7)+(39,618)(128)}{60,414}$	
gm/gal	7.47		9.9		347.4		50.5		102.4	
$lb/10^3$ gal [a]	16.4		21.8		765.2		111.3		220	

[a]Input to Area 2 Program/presented in Table A-1.

weighted average of light duty motor vehicle emission factors and diesel motor vehicle emission factors, was applied to the composite fuel total. Since smaller engines are probably not as efficient as larger engines, this was felt to be a reasonable approach. The derivation follows in Table 3-1.

Total estimated emissions for the off-highway vehicles category, including both gasoline and diesel fuel users, are as shown:

Source category	Total emissions - 1973, ton/yr				
	Partic.	SO_x	CO	HC	NO_x
OFHIVEH	76.7	101.9	3578.5	520.5	1028.8

Projections

Although unobtainable, State projections of fuel consumption for this category would depict the most accurate usage. Therefore, they were based on population growth projections.

Year	1973	1975	1980	1985
Total population	95,804	98,087	105,644	114,492
Growth factor	base	1.02	1.10	1.20
OFHIVEH fuel usage (10^3 gal/yr)	9,353	9,540	10,288	11,224

It is to be noted that, since off-highway vehicles are essentially uncontrolled, the 1973 emission factors have been assumed to apply through 1985 (Tables A-2, A-3, A-4).

Subarea Distribution

The calculation of emissions from this category is based almost entirely on population. The allocations of emissions

to each grid were, therefore, distributed proportionately to the grid population of each study year. These distributions are shown in Appendices G through J.

4. COMBUSTION OF SOLID WASTES
(Controlled and Uncontrolled)

OPEN BURNING (OPENBUR)

Area-Wide Emissions

There are three classifications that should be considered in this category: a) leaf burning outside the urban services area, b) residential on-site burning and c) unintentional structural fires.

a) The residential area outside the urban services area was assumed to include primarily older rural homes, where leaf raking is often not done, and newer suburban development homes, where trees are rarely large enough to produce enough leaves to require raking and burning. This, therefore, was considered a negligible category.

b) In Georgia, open burning in counties with a population greater than 65,000 is prohibited. All the counties in the study area come under this restriction. However, it is probably that a sizable amount of residential refuse still is disposed of by open burning. Therefore, the policy set forth by GA. DNR of allowing 0.5 lb refuse burned/cap.-day was adopted here as being a reasonable estimate. Commercial and industrial open refuse burning were considered negligible.

Total res. refuse
combustion (ton/yr) = (0.5 lb/cap-day)(365)(95,804)(ton/2000 lb)
= 8,742 ton refuse burned/yr.

In computing emission factors for this subcategory, it was assumed that the waste was a mixture of municipal refuse, wood refuse, and landscape refuse and pruning waste. Therefore, the computed emission factors were the arithmetical average of the factors given for these classifications in AP-42. These EF's were further averaged with those pertaining to unintentional structural fires to yield a weighted average set of emission factors for the entire category (Table A-1).

c) Unintentional structural fires in 1973 numbered 383 in Dougherty County area.

Due to the difficulty in obtaining accurate structural damage in any specific area, a per capita factor was used in determining the number of structural acres for all of Dougherty County.[1]

STRUCTURAL FIRES AND PROJECTIONS - 1973 THRU 1985

	1973	1975	1980	1985
Population	95,804	98,087	105,644	114,492
Factor	4 fires/ 1000	4 fires/ 1000	4 fires/ 1000	4 fires/ 1000
Number of structural fires	383	392	422	458
Factor	5 tons/ fire	5 tons/ fire	5 tons/ fire	5 tons/ fire
Ton of fuel burned	1,915	1,960	2,110	2,290

These structural fires are for both incorporated and unincorporated land area in Dougherty County.

	Material consumed (tons/yr)			
	1973	1975	1980	1985
Unauthorized burning	8,742	8,950	9,640	10,447
Structural burning	1,915	1,960	2,110	2,290
OPENBUR (ton/yr)	10,657	10,910	11,750	12,737

Emission factors for this subcategory were derived from the wood refuse table in AP-42 and an overall weighted EF for both subcategories of this source was computed (Table A-1), since it was desired that they be combined as an entity for calculation purposes. These EF's then, were input with the total fuel consumed into the Area 2 Program to calculate pollutant emissions:

Source category	Total emissions - 1973, ton/yr				
	Part.	SO_x	CO	HC	NO_x
OPENBUR	89.0	1.1	331.4	82.1	16.0

Projections

Projections have been based on increases in total county population and are listed in the text.

Subarea Distribution

Computed emissions were allocated to grid cells proportional to each grid's study year population and are tabulated in Appendices G through J.

INCINERATION (INCINERA)

Area-wide Emissions

A listing of all known non-point source incinerators in the study area, the type and quantity of refuse burned in each, and the number of days operated per year was recently compiled by Georgia DNR. This listing is shown in Table 4-2. While the data are representative of 1975, not the base year 1973, they probably provide the best available estimate of the 1973 refuse burning rates for the incinerators still in operation. However, the total refuse burned could be low because several incinerators may have been shut down during 1973 and 1974. Nevertheless, in the absence of more detailed information, it was assumed that the total refuse burned in 1973 equalled that presented for 1975.

Commercial incinerators were assumed to be multiple chamber unless indicated as pathological or otherwise. Sewage sludge incinerators were assumed to be controlled.

Then, to arrive at emissions:

Incinerator emissions (ton/yr) = (lb. refuse burned/day)(days operated/year)(ton/2000 lb)(lb. pollutant emitted/ton refuse burned)(ton/2000 lb)

The total refuse combusted in this category was 1,842 ton/yr and the total emissions are:

Source category	Total emissions - 1973, ton/yr				
	Particulate	SO_x	CO	HC	NO_x
INCINERA	7.65	2.27	2.58	2.63	10.76

Table 4-1. NON-POINT SOURCE INCINERATORS - 1973

Incinerator	Grid	lb/day	day/yr	ton/yr	Pollutants ton/yr				
					Part.	SO_x	CO	HC	NO_x
Hospital									
Palmyra Park Hospital P.O. Box 1908, Albany	4	20	260	2.6	.02			.02	.03
Phoebee Putney P.O. Box 1828, Albany	10	300	365	55.0	.2	.07	.08	.08	.3
Commercial									
Piggly Wiggly Hwy. 82 East Albany, Ga.	16	2,000	313	313	1.1	.4	.5	.5	1.6
Piggly Wiggly 1001 N. Slappy Dr.	10	2,500	312	390	1.4	.5	.6	.6	2.0
Piggly Wiggly S. Slappy Dr.	14	2,000	313	313	1.1	.4	.5	.5	1.6
Eckerd Drugs, Inc. 2401 Dawson Rd. Albany, Ga.	3	30	312	4.7	.03			.03	.04
Eckerd Drugs, Inc. 1600 E. Oglethorpe Expressway, Albany	16	600	312	94	.3	.1			.5
Harvey's Supermart U.S. Hwy. 82 - 19	16	1,250	312	195	.7	.2	.3	.3	1.0
Industrial									
Durham Iron Co. P.O. Box 198 Albany, Ga.	11	2,500	300	375	1.3	.5	.6	.6	1.9
Government									
Marine Corp. Supply Center, Albany, Ga.	17	800	250	100	1.5	.1			1.75
Daily refuse burned		12,000							
Yearly refuse burned emissions produced				1,842	7.65	2.27	2.58	2.63	10.75

Projections

There has existed a recent trend to shut down on-site incinerators and use compactors or dumpsters for commercial, institutional, and industrial solid waste disposal. However, this trend probably will moderate because all of the remaining incinerators are expected to become in compliance with air pollution control regulations and will not require expensive upgrading. Most incinerator operators probably will not change their means of waste disposal unless the economics of an alternate disposal method change or the facility moves or is renovated. Also, the possibility of new on-site incinerators exists. Therefore, it has been assumed that solid waste disposal in and emissions from on-site incinerators will remain almost constant over the next ten years at the estimated 1975 level.

Subarea Distribution

The street addresses of all the on-site incinerators are known (Table 4-2). Therefore, emissions for 1973 and succeeding projection years have been allocated directly to the appropriate grids by totaling the amount of refuse burned and resulting emissions in each grid. Thus, emissions are summarized as "additional emissions" under the INCINERA category in the Area 2 Program printouts (Appendices G - J) and total emission summaries (Tables 1-1, 1-2, 1-3 and 1-4).

FOREST FIRES AND AGRICULTURAL BURNING (FFAGBUR)

Area-wide Emissions

In 1973, unintentional forest and grass/field fires burned 564 acres in Dougherty County. Agricultural burning consumed another 4,944 acres in the same year. An estimate obtained for the fuel consumed per forested acre under fire is 9 tons wood/acre.[1] Table 4-2 summarizes the pertinent data:

Table 4-2. FOREST/GRASS/FIELD FIRES - 1973

County	No. acres burned by forest fires	No. acres burned by agricultural fires	Total fuel (wood) consumed by fires (ton/yr)
Dougherty	564	4,944	49,572

Emission factors for this category were taken from AP-42 and when entered into Area 2 Program produced the following total emission:

TOTAL EMISSIONS - 1973, ton/yr

Category	Part.	SO_x	CO	HC	NO_x
FFAGBUR	421.4	0.0	2478.6	495.7	49.6

An unusual high number of both forest and agricultural fires were produced in 1973. For purposes of projection, it was felt that a three year average would be more accurate for both 1975 and the future years.

	1973	1974	1975	Totals
Time span (months)	12	12	12	36 months
Acres burned	5,508	4,041	4,228	14,377 acres

$\bar{X}$ average burn per month 399 acres

(12) ($\bar{X}$) average burn per year 4,792 acres

Projections

Climatic factors will heavily influence the occurrence of unintentional forest and field fires on a year to year basis and predicting future trends is quite difficult. Emissions from this category, however, may decline as suburban development encroaches on heretofore undeveloped forested land. Based upon total population increases in the unincorporated areas of the counties containing grids with forested acreage, the acreage burned for each projection year was adjusted downward by a factor equal to the product of the percent population increase and the ratio of the urban to the forested area.

	1973	1975	1980	1985
Population	95,804	98,087	105,644	114,492
Growth factor	given	base	1.08	1.17
Adjusted growth factor	given	base	.93	.86
FFAGBUR fuel usage (ton/yr)	49,572	43,131	40,112	37,093

Subarea Distribution

Allocation of emissions from FFAGBUR in Dougherty County to grid cells was done by the Area 2 Program proportional to the forested acreage per grid. The total forested watershed acreage per county, exclusive of cropland, populated, or highway acreage, was obtained from the Georgia Forestry Commission.[23] The forested acreage for each grid was estimated from USGS maps. These estimates were subsequently totaled by county and forced to fit the actual county totals.

5. OTHER SOURCES

EVAPORATIVE LOSS SOURCES (EVAPLOS)

Area-wide Emissions

This category considers emissions from gasoline handling losses, dry cleaning losses, and surface coating and miscellaneous solvent-use operations. No local survey data was available to estimate HC losses from these sources; therefore, procedures outlined in Reference 1 were employed.

1. Solvent Use:

Emissions were computed under this subcategory for dry cleaning operations only. From the per-capita emission factor given in Reference 1 and the per ton emission factor presented in Reference 25, a per-capita use factor was developed, due to the necessity, when using the Area 2 Program, to enter the fuel usage total and emission factor in compatible units.

$$\text{Per capita use factor} = \frac{2 \text{ lb HC emitted}}{\text{capita-year}}$$

$$257.5 \frac{\text{lb HC emitted}}{\text{ton solvent used}}$$

$$= 15.5 \frac{\text{lb solvent used}}{\text{capita-year}}$$

Solvent use emissions for the Albany county region in 1973 are:

Solvent used (ton/yr) =

$$\frac{(95{,}804)\left(\frac{15.5 \text{ lb/solvent}}{\text{cap.-yr}}\right)}{2{,}000 \text{ lb/ton}} = \underline{742 \text{ ton/yr}}$$

The emission factor for this subcategory is the average of the published (AP-42) factors for petroleum and synthetic solvents - 257.5 lb/ton.

2. Surface Coating Operations:

The per-capita solvent use factor[18] - 28 $\frac{\text{lb solvent used}}{\text{capita-year}}$ was used to calculate total solvent use:

$$\text{Solvent used (ton/yr)} = \frac{(95{,}804)\left(28\frac{\text{lb solvent used}}{\text{capita/yr}}\right)}{2{,}000 \text{ lb/ton}}$$

$$= \underline{1{,}341 \text{ ton/yr}}$$

The emission factor for this subcategory is the average of the factors for 5 surface coatings - 1,164 lb/ton (AP-42).

3. Gasoline Handling Losses:

The splash filling and liquid spillage losses associated with the filling of motor vehicle gas tanks were the only emission sources considered under this subcategory. Emissions from petroleum storage tanks were assumed to have been accounted for by point source inventories.

From county fuel sales reports for 1973, gasoline usage is:

Total gasoline usage in study area = $491,222 \times 10^3$ gal/yr

$$= \frac{(491,222 \times 10^3 \text{ gal/yr})(6.17 \text{ lb/gal})}{2,000 \text{ lb/ton}}$$

$$= \underline{1,515,420 \text{ ton/yr}}$$

It is assumed that all the gasoline sold in the area but not consumed there equals that sold elsewhere but consumed in the area.

The emission factor for this subcategory equals:

$$\begin{aligned} EF = {} & 11.0 \text{ lb}/10^3 \text{ gal pumped (vapor displacement loss)} \\ & \underline{+0.67 \text{ lb}/10^3 \text{ gal pumped (liquid spillage loss)}} \\ = {} & 11.67 \text{ lb}/10^3 \text{ gal pumped} \end{aligned}$$

Converting units:

$$EF = (11.67 \text{ lb}/10^3 \text{ gal})\left(\frac{10^3 \text{ gal}}{3.1 \text{ ton}}\right) = \underline{3.8 \frac{\text{lb HC emitted}}{\text{ton gas pumped}}}$$

The overall emission factor for this category is a weighted average of the factors for the above 3 subcategories, since a combined input to the Area 2 Program was desirable. Its derivation follows:

$$\overline{EF} = \frac{(11,802)(257.5)+(21,319)(1,164)+(2,797,595)(3.8)}{(11,802 + 21,319 + 2,797,595)}$$

$$= \underline{13.6 \frac{\text{lb HC emitted}}{\text{ton solvent used}}}$$

Total hydrocarbon emissions from evaporative loss sources equal:

Source category	HC emissions - 1973, ton/yr
Solvent use	96
Surface coating	780
Gasoline handling	2,879
Total	3,754

Projections

It is not anticipated that solvent usage rates will fluctuate greatly during the period of accountability of this study. It always remains a possibility, however, that more refined control measures will be implemented for this essentially uncontrolled category. In the absence of more sophisticated estimation techniques, projections for all evaporative loss sources are based solely on the total population increase in the Dougherty county study area. Projected solvent/gas usage and corresponding EVAPLOS emissions are:

Year	1973	1975	1980	1985
Total population	95,087	98,087	105,044	114,492
Growth factor	base	1.02	1.10	1.20
Solvent/gas usage (ton/yr)	1,517,503	1,547,853	1,669,253	2,200,379
Total HC emissions (ton/yr)	3,754	3,829	4,129	4,505

Subarea Distribution

Emissions were distributed to grid cells proportional to the total population of the cells during the respective study year (Appendices G through J).

FUGITIVE DUST - UNPAVED ROADS (FDUNPRD)

Area-wide Emissions

There were 136.6 miles of unpaved roads in Dougherty County reported in the 1973 inventory of roads prepared by the Georgia DOT.[24]

Transportation department personnel provided a state-wide estimate of average daily traffic (ADT) on county unpaved - of 77 vehicles/day.

The annual VMT then, is:

$$\text{VMT (Annual)} = (77 \text{ veh/day})(136.0 \text{ mi roads})(365)$$
$$= \underline{3{,}839 \times 10^3 \text{ VMT/yr}}$$

The emission factor for unpaved roads was obtained from the EPA report, Development of Emission Factors for Fugitive Dust Sources,[26] assuming a gravel roadbase with an average silt content of 12 percent, and an average speed of 30 mph on the roads.

$$\text{EF (unpaved roads)} = 0.81\, s\left(\frac{S}{30}\right) = 0.81(12)\left(\frac{20}{30}\right)$$
$$= 6.48 \text{ lb/VMT}$$

The value was corrected downward to account for the relative climatic factors between the area in which the factor was developed and Albany and by the annual percentage of time during which no emissions would occur because of rainfall, to yield a revised emission factor of 1.109 lb/vehicle-mile traveled.

The correction factor derivations are:

Climatic factor:

C_1 (Franklin County, Kansas)[26] = 0.1

C_2 (Dougherty County, GA)[26] = .025

C (relative) = C_2/C_1 = 0.25

Surface moisture:

No. days with >0.01 in. precipitation[26] = 115

$$\text{EF (unpaved roads)}_{\text{corrected}} = (6.48 \text{ lb/VMT})(0.25)\left(\frac{365-115}{365}\right)$$

$$= \underline{1.109 \text{ lb/VMT}}$$

$$= \underline{1{,}109 \text{ lb}/10^3 \text{ VMT}}$$

The resulting area-wide emissions were then calculated and apportioned by the Area 2 Program.

$$\text{FDUNPRD Emissions} = (3{,}839 \times 10^3 \text{ VMT/yr})(1{,}109 \text{ lb}/10^3 \text{ VMT})\left(\frac{\text{ton}}{2{,}000 \text{ lb}}\right)$$

$$= \underline{2{,}128.8 \text{ ton/yr}}$$

Projections

Observations can be made regarding certain classifications of unsurfaced roads, leading to the conclusion that the total VMT may remain constant over the next 10 years.

First, most of the county maintained unpaved roads lead to rural residences, farming districts, or recreational areas and forested land. Therefore, volume on these roadways is unlikely to increase proportionately with total traffic volume for the counties. Secondly, if traffic on a road

were to increase significantly as a result of a new trip generator along the road, the road would probably be paved at that time. Thirdly, roads in new residential areas that are to be paved by developers when building construction phases are completed will be replaced by similar under-construction developments in future years.

For lack of any definitive information, it has been assumed that traffic volume on unpaved roads will remain constant over the next 10 years.

Subarea Distribution

All fugitive dust emissions from unpaved roads were allocated directly to grid cells based on the measured mileage of unpaved roads contained in each.

FUGITIVE DUST - PAVED ROADS (FDPAVRD)

Area-wide Emissions

Initially, inclusion of this source category in the area source inventory was not intended, due to the paucity of available data and procedures on which to base emission estimates. However, this source is becoming recognized as a significant contributor to the total particulate loading in many areas, and it was concluded that some quantitative estimate should be included, in spite of the paucity of pertinent data.

It must be emphasized that the derivations presented below do not have the same accuracy as calculations in other sections of this report, and the resulting emission estimates are only order-of-magnitude values. In recognition of this and in anticipation of future refinements of these estimates, this source category has been separated from the remainder of the categories in all data summaries.

Seattle Study - Only one study was found in which any pertinent data have been published.[27,28] From a single test of a paved road that was flushed and swept regularly, field sampling showed an emission rate of 0.14 lb/VMT, with 0.0055 lb/VMT (2.5 grams/VMT) below 10 micrometers in size. Three tests of dusty paved roads, in areas with construction projects or near unpaved roads where dirt was tracked onto the pavement, indicated an average emission factor of 0.83 lb/VMT with 0.17 lb/VMT (77 grams/VMT) under 10 micrometers.

A major concern with these reported values is the sampling method used--impaction samplers were mounted in an array on

a trailer towed behind the test vehicle. Most of the re-suspended material collected in the area of turbulence on the roadway would have an impact on air quality only in this limited area and not on a regional scale. This sampling method does not allow for settling and, more importantly, it may pick up particulate matter generated by many preceding vehicles, not just the test vehicle.

Example emission calculations presented in Appendix 4 to the publication[27] show substantial reductions from the emission rates cited above, although these reductions are not made for the purpose of compensating for the sampling method. In calculating annual emissions, the authors assume that:

1. dust is emitted from the road 200 days/year (in Seattle);
2. the "dry emission factor" is 30% less than the values presented;
3. average dusty paved roads emit at only 50% of the rate for the three roads tested; and
4. the sample of under 10 microns is comparable to the suspended particulate emitted.

No data are presented to support any of these assumptions.

If the emission factors and assumptions from this study are applied to Dougherty County data, and it is additionally assumed that roads in Dougherty County would be similar to the tested street that was cleaned regularly, the following results are obtained:

$$EF \text{ (corrected)} = (0.0055 \text{ lb/VMT})(0.7)\left(\frac{250}{365} - \frac{\text{days with}}{\text{no rain}}\right)\left(\frac{10^6}{10^6}\right)$$

$$= \underline{2{,}643 \text{ lb}/10^6 \text{ VMT}}$$

The 50 percent correction factor was not used, since it applied specifically to uncleaned streets.

Thus, total emissions are:

$$\text{FDUNPRD Emissions} = (358.8 \times 10^6 \text{ VMT/yr})(2{,}637 \text{ lb}/10^6 \text{ VMT})\left(\frac{\text{ton}}{2{,}000 \text{ lb}}\right)$$

$$= \underline{474 \text{ ton/yr}}$$

Of course, the total VMT traveled and the EF were input to the Area 2 Program to calculate apportioned emissions (Appendices D through P).

Chicago Study - The American Public Works Association (APWA) is presently conducting a study to determine the environmental benefits of improved street cleaning. In conjunction with the Chicago Department of Environmental Control and IIT Research, they are microscopically examining hi-vol filters from street canyon exposures in an attempt to determine the origin of the particulate matter. They have not yet reached final conclusions, but preliminary indications[29] are that auto exhaust accounts for only 25 percent of motor vehicle impact, with the remainder from resuspended dust and tire wear. Using this 25 percent factor and particulate emission factors from Chapter 3, an average emission factor for the road dust portion can be approximated:

(0.25)(TMVPEF)*	=	0.34 grams/VMT
TMVPEF	=	1.36 grams/VMT
FFPAVRD	=	TMVPEF - exhaust - tire wear - brake wear

* Total motor vehicle particulate emission factor.

$$= 1.36 - 0.34 - 0.20 - 0.02$$
$$= 0.8 \text{ grams/VMT}$$

With this factor, fugitive dust from paved roads in Albany would equal 316 ton/yr. For an initial estimate, it is proposed that the value from the Seattle Study be used in order to pressure the "worst case" analysis.

Projections

At this point, it cannot even be established that VMT is the best indicator of dust emissions from paved roads. Emissions are possibly more closely related to miles of road surface or some other parameter. However, since the current emission estimates are based on VMT, future emissions can reasonably be assumed to increase proportionately to VMT. These emissions are:

Year	1973	1975	1980	1985
Estimated total VMT ($x10^6$)	359	384	452	493
Growth factor	base	1.07	1.25	1.37
FUPAVRD emissions (ton/yr)	474	508	596	652

Subcounty Distribution

To maintain consistency, dust emissions from paved roads have been allocated based upon the total VMT in each grid for the study years. The distributions of estimated emissions from dust on paved roads are shown in Appendices D through P.

FUGITIVE DUST - AGRICULTURAL TILLING (FGDAGTIL)

Area-Wide Emissions

Windblown dust from tilled fields was estimated by use of the wind erosion equation, a procedure explained in detail in Reference 26. Briefly, a separate emission factor is established for each crop type in an area as a function of resistance to wind erosion provided by that crop and plowing methods normally used with it. The emission factors also vary according to the common soil types found in agricultural land in an area and its climate. The fugitive dust component generated by the actual implement tilling operation has also been estimated.

Emission calculations for tillage operations account for the limited periods when the farming equipment is actually used in the fields; they do not account for the lower level emissions that occur periodically as a result of wind erosion across the fields. Annual emissions from tilling may be quite small in comparison with suspended particulate emissions generated by wind erosion.

In order to simplify the calculations involved and to account for gaps in the available data on crop types, three main categories were created:

1. Pasture - acreage lying in fallow, and that used for grazing, e.g. alfalfa, timothy, rye, safflower, grasses.
2. Harvest - barely, corn, cotton, grain, hay, oats, sorghum, soybeans, sugar beets, wheat.
3. Truck - Beans, peanuts, potatoes, vegetables.

The total acreage devoted to pasture and/or cropland in the Dougherty County region in 1973[31] was 37,147 acres, consisting of cotton, soybeans, corn, wheat, tobacco, peanuts. The acreage harvested by small truck farms and other sources was considered negligible, as was acreage devoted to hay, since data pertaining to these categories was unobtainable.

The modified form of the wind erosion equation is:

$$E_w \text{ (tons/acre/year)} = aICKL'V' (\pm 5\%) \qquad (26)$$

where,

a, I, C, K, L', V' are quantities and factors defined in Table 5-1, in which windblown dust emissions from the tilled acreage in the county are presented in tabular form. The total particulate emissions from the windblown component are seen to be 92.16 ton/yr.

The emission factor for tillage operations is estimated by the following equation:

$$E_t \text{(lb/acre)} = \frac{1.4s(S/5.5)}{(PE/50)^2} \quad (\pm 15\%) \qquad (26)$$

where,

S = implement speed (mi/hr) - assumed to be 5.5 mph

s = silt content of soil (%) - assumed to be 10%

PE = thornthwaite's precipitation-evaporation index = 116 for the study area[26]

The calculated tillage EF then, was 3.5 lb/acre. Fugitive dust emissions by county then were calculated:

County	acres tilled	EF(lb/ acre)	No. tillings per year	T/2,000 lb	FD. emissions (ton/yr)
Dougherty	15,429	3.5	3	T/2,000 lb	81.0

* Agricultural land excluding pasture acreage, and 3,318 acres of harvest land that is expected to be covered with wheat.[31]

The total fugitive dust emissions from agricultural activity are presented by county:

Subarea Distribution

From information contained in Reference 47 and USGS quanrangle maps, the grid cells most likely to contain agricultural activity were estimated to Be Nos.: 1, 2, 3, 4, 7, 8 13, 16, 17, 18, 19, 20, 22, 23, 24, 25, 26. These grids were added to the Area 2 Program as "Additional Emissions."

Projections

In the years ahead, the state expects a 30 percent increase in soybeans harvested and a 5 percent increase in corn, although much less for the urbanized counties under study here.[31] However, a decrease in total acreage harvested is also forecast as urban land development encroaches further into traditional farm areas.

Quantitative projected estimates were determined from land use projection maps, as being an inverse of urban-suburban expansion.

Source category	1973	1975	1980	1985
RES/COM/IND land use (acres)	20,204	32,226	42,364	51,308
Growth factor	base	1.60	2.09	2.54
Corrected growth factor	base	.62	.48	.39
Dougherty Co. agricultural acreage (less pasture)	18,747	11,623	8,998	7,311
Fugitive dust from agricultural activity (ton/yr)	173.1	107.6	68.7	67.0

Table 5-1. FUGITIVE DUST EMISSIONS FROM AGRICULTURAL FIELDS DUE TO WIND EROSION - 1973

County	Crop	A, acres	L, field length	V, vegetative cover	I(T/ac-yr), based on soil type	C, climatic factor	K, surface roughness	L', length factor	V', vegetative factor	E = AaICKL'V'* windblown dust emissions by crop (ton/yr)
Dougherty	pasture	18,400	667	2,000	134	.02	1.0	.9	Neg.	Neg.
	harvest	16,995	667	780	134	.02	.6	.74	.15	76.09
	truck	1,752	167	100	134	.02	.6	.3	.75	16.07
									Study area total	92.16

* Where a = portion of total wind erosion losses that would be measured as suspended particulate, estimated to be 0.025.

Table 5-2. TOTAL EMISSIONS FROM AGRICULTURAL ACTIVITY - 1973

County	Acres tilled	Emissions from implement tilling operations (ton/yr)	Emissions from wind erosion- from Table 5-1 (ton/yr)	Total agricultural associated emissions (ton/yr)
Dougherty	15,429	81.0	92.16	173.1

FUGITIVE DUST - CONSTRUCTION (FGDCONST)

Area-wide Emissions

For purposes of estimating emissions, four different types of construction were identified: industrial, commercial/ institutional, residential, and highway.

Dollar values for construction activity by category for Dougherty County, were obtained by contracting the local Chamber of Commerce. Due to the nature of the agencies records system, no breakdown by location, or surface area exposed to construction activity were possible, for this reason, it was felt that in order to obtain the greatest amount of accuracy, established dollar value to surface area conversion factors would be used. The areas determined would be located and projected by land usage.

Factors from AP-42 were used to convert dollar values to surface area exposed to construction:

Residential:

Dollar value of residential building permits (times)		11.1×10^6
AP-42 conversion factor	x	8 acres/1.0×10^6 dollars
Total acreage exposed to residential construction	=	88.8 acres
Commercial-institutional-industrial dollar value of building permits		7.7×10^6 dollars
(times) AP-42 conversion factor	x	8 acres/1.0×10^6 dollars

Total acreage exposed to institutional-commercial-industrial 61.6 acres

(times) percentage commercial-institutional x .64

Total acreage exposed to institutional-commercial construction = 39.4 acres

Total acreage exposed to industrial construction = 22.2 acres

Emission factor for fugitive was taken from AP-42 as 1.2 ton/month and corrected for climatic factors and conditions specific for Albany, Georgia.

$$1.2 \text{ ton/month} \times 12 \text{ month/yr} \times \frac{30^2}{(PE)^2} = 1.296 \text{ ton/acre-yr}$$

PE - Precipitation-evaporation index = 100

Category	Acres exposed to construction	Conversion factor		Tons fugitive dust/category
Residential	88.8	1.296	=	115.1 ton/yr
Commercial-institutional	39.4	1.296	=	51.1 ton/yr
Industrial	22.2	1.296	=	28.7 ton/yr
Highway	253.1	1.296	=	328.0 ton/yr

Projections

Projections for residential, commercial-institutional and industrial based on land-use development (Ref.8).

Highway projections based on present and proposed construction projects (Ref. 8).

FUGITIVE DUST FROM RESIDENTIAL CONSTRUCTION - PROJECTIONS

Year	1973	1975	1980	1985
Land-use residential (acres)	158.1	290.5	379.3	456.3
Growth factor	base	1.84	2.40	2.89
Fugitive dust emissions (ton/yr)	115.1	211.8	276.2	332.6

FUGITIVE DUST FROM COMMERCIAL-INSTITUTIONAL CONSTRUCTION - PROJECTIONS

Year	1973	1975	1980	1985
Land-use commercial institutional (acres)	19.9	22.5	31.1	40.5
Growth factor	base	1.12	1.56	2.03
Fugitive dust emissions (ton/yr)	51.1	57.2	79.7	103.7

FUGITIVE DUST FROM INDUSTRIAL CONSTRUCTION - PROJECTIONS

Year	1973	1975	1980	1985
Land-use industrial (acres)	10.9	13.1	18.2	22.4
Growth factor	base	1.20	1.67	2.05
Fugitive dust emissions (ton/yr)	28.7	34.4	47.9	58.8
Fugitive dust from highway construction	328.0	59.1	24.6	74.6
Total fugitive dust emissions - ton/yr	522.9	374.1	471.3	582.4

Table 5-3. FUGITIVE DUST FROM CONSTRUCTION BY GRID - 1973

Grid locator	Fugitive dust emissions - 1973, ton/yr				
	Residential	Commercial	Industrial	Highway	Total
1	3.6	0.4	0.0	0.0	4.0
2	7.3	0.5	0.8	24.6	33.2
3	5.9	0.6	0.0	37.9	44.4
4	2.5	3.1	0.7	57.8	64.1
5	0.7	0.0	0.5	0.0	1.2
6	1.4	0.0	0.0	0.0	1.4
7	2.2	0.6	0.0	9.8	12.6
8	0.6	0.0	0.0	44.3	44.9
9	11.7	3.1	0.7	24.6	40.1
10	8.7	10.8	1.0	13.7	34.2
11	2.2	2.6	4.4	48.0	57.2
12	4.2	1.1	1.0	67.6	73.9
13	11.6	3.1	0.0	0.0	14.7
14	8.7	8.4	0.9	0.0	18.0
15	4.2	5.0	0.5	0.0	9.7
16	3.1	1.9	4.2	0.0	9.2
17	8.8	1.9	0.0	1.9	12.6
18	2.2	0.4	0.0	0.0	2.6
19	1.1	1.0	5.9	0.0	8.0
20	2.5	2.6	0.4	0.0	5.5
21	2.5	0.6	0.0	0.0	3.1
22	0.7	0.5	2.6	0.0	3.8
23	3.6	0.4	0.0	0.0	4.0
24	3.6	0.6	0.0	0.0	4.2
25	7.3	1.3	3.7	0.0	12.3
26	3.6	0.4	0.0	0.0	4.0
Area total	115.1	51.1	28.7	328.0	522.9

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